Concrete

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Difficult Structural Concrete Work Placed in Baha'i Temple

Nine-Sided Structure Requires Complicated Form Work —Increase Workability of Concrete for Thin Sections— Concrete Ornamental Tracery on Superstructure

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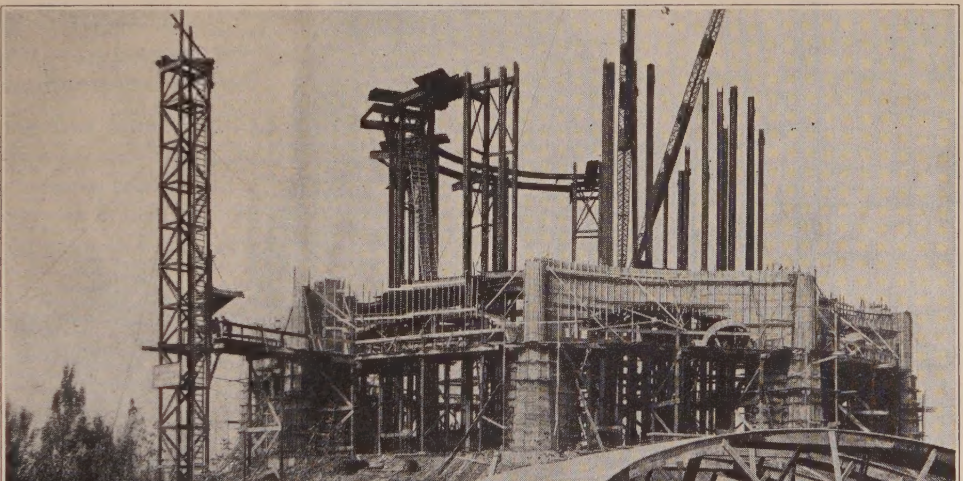
UNUSUAL architectural and structural design is represented in the Baha'i Temple, under construction at Wilmette, Illinois. It is a nine-sided polygon of steel and concrete framing, with a circular hall 72 feet in diameter surmounted by a dome having a clear height of about 138 feet.

The structure is built on caissons sunk to bedrock and on composite piles. The foundation was built some years ago and the basement was covered by a reinforced concrete dome. This dome permitted use of the uncompleted building as a meeting place.

The superstructure will be enclosed almost entirely with concrete ornamental tracery backed with glass.



Complicated concrete form work on nine-sided temple

Unusual Form Work a Feature

Due to the many unusual features of the design difficult problems were encountered in the construction of the concrete form work and the placing of the concrete itself. The work was practically a maze of curves, angles and arches, making the construction of these forms quite complicated.

Necessary Variations in Workability

Great care had to be exercised in proportioning the mix of the concrete because the workability had to be varied in relation to the size and construction of the different members.

Placing of concrete in window mullions and columns was quite a task, for it was impossible to work the concrete in these members with ordinary spades or rods. The columns and mullions are from 30 to 47 feet high, and in some instances the width is only 4 inches. Rubber mallets were used to vibrate the forms in order to get maximum density and to cover the reinforcing bars.

Increased workability of concrete was obtained for structural members of thin section, by reducing the proportion of coarse aggregate in the mixture.

The entire responsibility for obtaining the desired strength of concrete and the varying of the workability for mixes so as to conform to the various conditions, as well as the proper curing of the concrete, was in the hands of a supervisor of the Robert W. Hunt Company, for whose services we have the highest regard.

Designing the Concrete Mixture

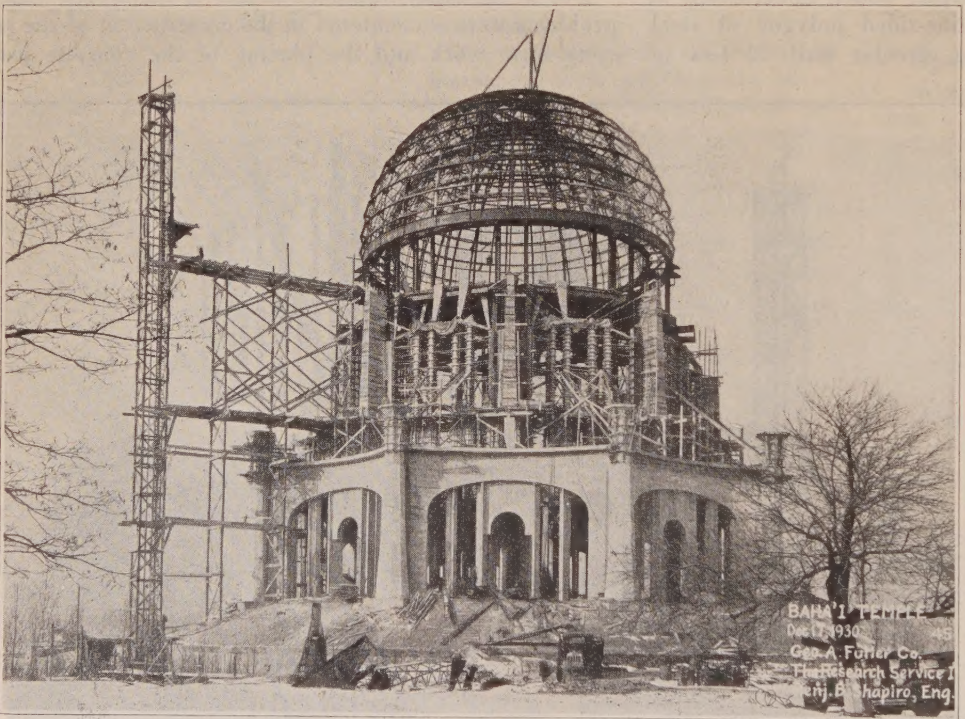
After selecting and analyzing the aggregates a mix was designed for a minimum strength of 2,500 pounds per square inch, taking into consideration the strength of the cement and the amount of water. Screen analysis of the aggregates was run daily to insure uniformity of the barrel of uniform diameter in which was placed a graduated rod. Mixing time was 1½ minutes per batch.

High early strength enabled us to save considerable on the form material and labor through frequent re-use of the forms.

Protection Against Cold Weather

Since a large portion of the concrete was placed in mid-winter, protection had to be provided. Salamanders and canvas covering were used. Due to the height of the columns and the location of different members it was difficult to protect freshly placed concrete in freezing weather; and it was necessary to discontinue concreting when weather reports indicated probability of temperatures below 20 deg. F. Daily communication with the weather bureau was of considerable assistance in selecting suitable weather for concreting operations. The temperature of the concrete when placed ranged from 70 to 100 deg. F.

Aggregates and water were heated by steam boilers. Live steam was used in cleaning the forms and steel reinforcement of ice and snow, previous to the depositing of concrete.



Structural concrete and frame work approaching completion. Observe slender reinforced concrete window mullions

materials. The fineness modulus of the sand varied from 2.7 to 3.15; and the fineness modulus of the stone varied from 7.3 to 7.5.

A slump of 7½ inches was used on the thin sections and 5 inches on the other portion of the work.

The yield obtained from one sack of cement was 5.6 cubic feet of concrete, so that the cement factor was 4.82 sacks to the cubic yard of concrete.

The average 28-day compression test result was 2,900 pounds per square inch; the average 7-day compression test result was 1,500 pounds.

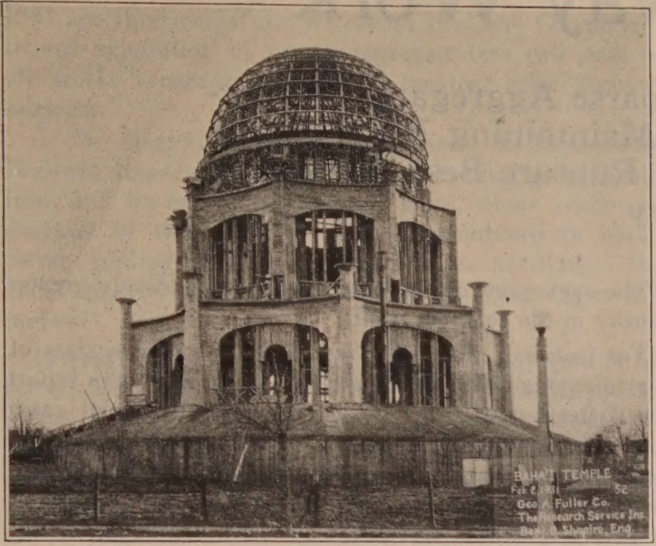
Accurate water control was maintained by using a metal

Two test cylinders were made daily, one for 7 days (job control) and one for 28 days (standard). These were later sent to the laboratories for proper curing and testing.

All reinforcing steel and cement used on the job were tested by the Robert W. Hunt Company.

Acknowledgments

The Research Service, Incorporated, of Washington, D. C., acted as managing and supervising engineers. The architect for this building was the late Louis Bourgeois of Wilmette, being succeeded by the structural engineer, Benjamin B. Shapiro of Chicago, who had full charge in the field. The George A. Fuller Company of New York was the general contractor and the Adolph Lindstrom Company of Chicago was the subcontractor on the concrete work.



Another view of the Baha'i Temple, Wilmette, Illinois, as it appeared six weeks later, when concreting was nearly completed

Cast Stone Institute's Convention to Cover Many Subjects

Meet in Cleveland This Month—Important Problems on Program—All Manufacturers Invited

The annual convention of the Cast Stone Institute will be held in Cleveland, Ohio, May 11 and 12, at the Hotel Cleveland. Every cast stone manufacturer who is interested in the future of the industry is invited to attend this meeting, whether or not his company is a member of the Institute.

Institute Making Good Progress

The organization's third annual report, to be presented at the Cleveland convention, will show that considerable progress has been made during the past year in establishing wider recognition for standards of quality in cast stone, in arousing greater interest among manufacturers in improving their product, and in demonstrating the effectiveness of co-operative action in solving the problems of the industry.

Papers on Important Subjects

It is felt that the convention program will be of unusual interest to cast stone manufacturers. P. H. Bates, of the United States Bureau of Standards, will discuss research as it is applied to concrete. He will explain the fundamental principles upon which scientific research is based and he will also explain the interpretation and application of the results of research. C. H. Randolph, of the Minnesota Mining and Manufacturing Co., will explain and demonstrate some recent developments in stone finishing methods and equipment which are rapidly revolutionizing the granite, marble and stone industries and which offer exceptional opportunities to cast stone manufacturers. A comprehensive report will be made by C. G. Walker, assistant secretary, on the status of cast stone in government building and the prospects for a more extensive use of it in such work. A number of other interesting papers are also on the program.

Information as to hotel accommodations and railroad rates can be obtained from the assistant secretary of the Institute at 33 West Grand Avenue, Chicago.

Large Users May Buy Cement Direct at Lowest Mill Price

Old Dealer Differential Abolished by Cement Companies—Action Practically Unanimous Among Manufacturers

In the course of the last few months various changes in cement marketing methods have finally resulted in the abolishment of the long-standing dealer discount by practically all cement manufacturing companies.

Under the new plans the cement companies will quote a flat price to dealers and large users alike. This will leave the dealers free to sell to their regular retail trade at whatever margin may be justified by the service they render.

On the other hand, the cement companies will sell direct (and at the same price quoted to dealers) to general contractors, to concrete products plants, to ready-mixed concrete plants, to federal, state and municipal construction departments, to the construction departments of railroads and other public utilities, and in general to all users who are equipped to handle cement shipments.

Program for Annual Meeting of Burial Vault Manufacturers Completed

The State Fair Grounds at Columbus, Ohio, have been selected for the forthcoming annual meeting of the National Concrete Burial Vault Association. The convention program, scheduled for May 21 and 22, has been completed and includes several good speakers.

Demonstrations of equipment for the manufacture of vaults will occupy the morning of the 21st. Two of the afternoon's events will be a paper to be read by E. G. Lantz on "Concrete Vaults and Their Finishes," and an address by Frederick U. Dodge on "Advertising."

Stanley L. Krebbs, noted lecturer, will talk on salesmanship on the morning of the following day. Early in the afternoon session W. D. M. Allan, chairman, is scheduled to present a report of work being done by A. C. I. Committee 709 on Standard Specifications for Concrete Burial Vaults.

A. S. T. M. to Exhibit Testing Apparatus During Annual Meeting

For the first time in its history the American Society for Testing Materials will sponsor an exhibit of testing apparatus and machines in conjunction with the annual meeting of the Society, at the Stevens in Chicago, June 22-26. The exhibit has been planned with a view to having a distinctly scientific and broadly educational atmosphere which will be consistent with the technical nature of the society's activities.

The exhibit is limited to equipment and apparatus used in the testing of materials and products, and recording and control equipment which is used in testing will be shown.

Controlling Quality of Concrete for State Highway Work

Many Specify Two Sizes of Coarse Aggregate—Proportion Aggregates by Weight—Maintaining Field Inspection and Control—Modulus of Rupture Best Measure of Quality

Here is an additional contribution to the fund of information on highway construction practice, continuing the group of articles started in the April issue.

This article presents a summary of practice in the making and testing of concrete for state highway work. The selection and proportioning of aggregates, the careful field inspection and control over mixing and placing, and the manner in which quality is checked by tests, are described by highway engineers at the request of "Concrete."

Other articles will follow in succeeding issues.—The Editors.

IN very few of the many uses for which concrete is employed is the material subjected to service and exposure conditions as severe as in highway and street pavements. Lying fully exposed to the extremes of temperature and other weather conditions, pavements are called upon to withstand the pounding of traffic that is constantly increasing in the number and weight of vehicles and in the weight of individual wheel loads.

Under the circumstances it is not surprising that state highway departments have given much of their energy toward the development of concrete that has great strength and a high degree of resistance to wear and temperature changes.

Present Practices in Making Concrete

Concrete of extremely high quality is not obtained by accident. The selection and proportioning of aggregates, the mixing proportions and the careful control over mixing and placing, all have played their part in producing present-day concrete.

The manner in which present results are accomplished, so far as these factors control the results, and the manner in which the results are checked and tested, are told by state highway engineers in a number of letters addressed to CONCRETE. These letters, coming from all parts of the United States, point out quite clearly the modern practices and trends.

Two Sizes of Coarse Aggregate

In discussing the selection and grading of aggregates, a surprisingly large number of states report the use of two sizes of coarse aggregates in order to improve the grading of the aggregates and to obtain a correspondingly greater density in the concrete itself.

For instance, nine states report the use of two sizes of coarse aggregate on practically all work, and three report specifying two sizes of coarse material in special cases where the aggregates supplied by the contractor are not well graded. In five states the aggregates available are naturally well graded, so that it has not been considered necessary to specify more than one size. Three additional state highway departments mention the intention to try out two sizes of coarse aggregates as an experiment. Six states report that they specify only one size of coarse material.

In California the standard practice is to require two sizes of fine aggregate as well as two sizes of coarse. Here, as stated by C. H. Purcell, state highway engineer, a field laboratory is maintained at the proportioning plant to combine the four sizes in a way to produce the most desirable grading.

In Texas, likewise, four sizes (two fine and two coarse) have been specified in a number of cases, although Gibb Gilchrist, state highway engineer, expresses the opinion that the use of three sizes (one fine and two coarse) is probably as far as it is economical to go in this direction.

W. W. Zass, engineer of construction for the Arkansas State Highway Commission, writes that during 1930 his department required two sizes of coarse aggregate on fully 50 per cent of the work as a means of improving the grading, which is based on the fineness modulus.

The practice in New Jersey, according to R. B. Gage, chemical engineer, is to specify two sizes of coarse aggregate, the quantity of each being determined by weight and combined so as to produce the densest mixture possible.

The repeated assurance that the use of two sizes of coarse aggregate improves the grading, and the consequent quality of the concrete, is well expressed by W. E. Hawkins, construction engineer, North Carolina State Highway Commission. "Practically all of our pavements," he states, "are now being constructed with coarse aggregate shipped in two sizes, and combined when the batch goes into the mixer. This separation of coarse aggregate into two sizes has enabled us to obtain a more uniform, consistent grading, which in turn has resulted in better concrete."

From Olympia, Washington, T. G. McCrory, chief engineer, State Department of Highways, writes that they require the separation of coarse aggregate into two sizes, the smaller size ranging from ¼ to 1½ inches, and the larger size from 1½ to 3 inches. These two sizes are then recombined in proportions that produce the best possible grading.

As a result of a number of experiments in 1930, the 1931 specifications of the Wisconsin Highway Commission require separation of coarse aggregate into two sizes on all work, according to W. C. Buetow, state highway engineer.

C. M. Ziegler, construction engineer, Michigan State Highway Department, writes: "We have had some special jobs, and we expect to construct more, where coarse aggregates of two or three sizes are combined to obtain better grading and less segregation in handling. Our usual size of coarse aggregate ranges from 1/4 to 2 1/2 inches."

In localities where well graded coarse aggregate is obtained from the commercial materials produced, the use of two sizes naturally becomes less important, because the main purpose of specifying two sizes of coarse material is to insure proper distribution of particle sizes from the smallest to the largest. In Rhode Island, for example, G. H. Henderson, chief engineer, State Board of Public Roads, states that most of the aggregates used in highway construction are produced at local gravel pits by small washing plants. This material, after being crushed, produces a fairly well graded aggregate. Oklahoma, Nebraska, Alabama and Arizona are other states where locally produced aggregates are well graded in size, so that the use of two sizes of coarse material is not deemed necessary.

Proportioning by Weight Almost Universal

Proportioning of materials by weight is almost universal, since 23 out of 26 states reporting employ this method. Several engineers mention the need for simpler and more accurate weighing equipment, although the generally expressed satisfaction with this form of proportioning suggests that in the few instances cited the contractors may not have been supplying the most modern equipment available.

A typical instance of modern proportioning methods is described in the letter from C. M. Hathaway, engineer of construction, Illinois Division of Highways, who writes: "We are now using the weigh-mix in proportioning; and, in addition, we have adopted a designed mix which is based on the mortar void theory."

The mortar void method is also discussed by Gibb Gilchrist, state highway engineer, Texas State Highway Commission, who declares that they have found the mortar void control much superior to any method previously tried. In New Jersey the proportion of fine aggregate is based on the void content of the coarse aggregate. Michigan, likewise, tests aggregates on the mortar void basis.

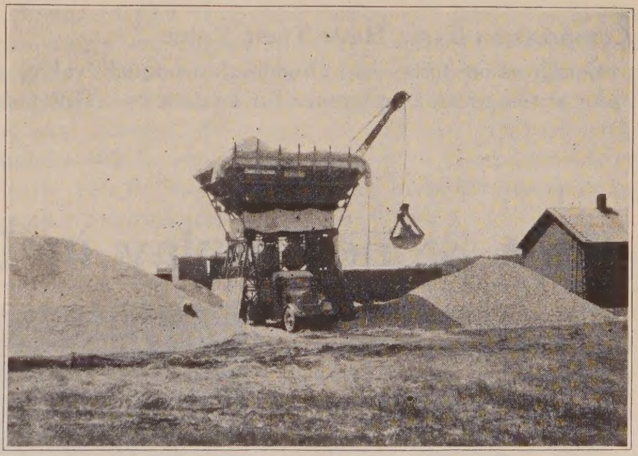
The greater accuracy of proportioning by weight, as compared with volume measurement, is discussed by William J. Titus, chief engineer, Indiana State Highway Department, who writes: "For the past three seasons we have used weight proportioning. Previous to that time volume measurement was used. We find that weight proportioning can be accomplished with no greater cost or inconvenience, and it is more accurate and satisfactory."

Field Inspection and Control

Hand in hand with proportioning by weight, highway departments have established other modern methods necessary to the making of good concrete, such as careful field inspection, positive control of mixing time, control of the water-cement ratio, minimum cement factor, and scientific design of mixtures.

The vast amount of detail involved in maintaining adequate field inspection and control may be visualized in the comments on this point by C. M. Hathaway, engineer of construction, Illinois Division of Highways. "The quality of concrete," he writes, "is controlled by careful inspection of the aggregates as to quality and gradation, the quality of cement, by a carefully designed mix of proper proportions, and by absolute control of the amount of mixing water used. Aggregates, cement and steel are inspected, in general, by representatives of the Division of Highways at the source of supply. The actual inspection of the concrete in the field is under the direct supervision of the resident engineer, who is provided with enough assistants to insure that each feature of the work is given constant inspection. During the placing of concrete in pavements and bridges, beams are taken daily and tested for modulus of rupture. After the pavements are completed, cores are taken to determine the compressive strength and as a check on the thickness."

It is of particular interest to note the practice in these respects in Louisiana, the state in which the 1931 program includes the construction of 1,500 miles of concrete pavement. "We believe that our methods of proportioning and our system of inspection," declares E. H. Kivett, physical testing engineer, Louisiana Highway Commission, "are adequate for obtaining uniform concrete of very high quality. In arriving at proportions for mixes we use what might be termed the trial method, since our specifications were prepared only after a thorough investigation by the laboratory as to the quality and grading of materials available. Several types of mixes are specified, dependent upon the grading of the coarse aggregate. A wide range in size among the coarse aggregates available makes the specifying of these several types of mixtures necessary. All pavements are drilled after completion, and the cores taken have thus far shown the concrete to be uniform and of very high quality."



Batcher bins and weighing equipment weigh aggregates for highway work in Minnesota

Detailed comment on the question of field control was received also from G. H. Henderson, chief engineer, Rhode Island State Board of Public Roads, who writes: "The quality of concrete is controlled by the pre-test of both the cement and the aggregates, and approval before their use, supplemented by continuous inspection of aggregates, especially those produced from local gravel pits. This field testing is followed up by check tests on samples of material taken twice a week by a representative of the state highway laboratory. On his visit to the various jobs this representative takes samples of the fine and coarse aggregates and makes up three beams and three cylinders entirely independent of the engineer on the job. The engineer on the job, on his part, makes daily beam tests primarily to gauge the time for opening the pavement to traffic. We ordinarily find fair agreement between the test results obtained by the laboratory representative and those obtained by the engineers in the field."

Beam Tests Favored

A very large majority of highway engineers favor the modulus of rupture test on 6 by 6 by 42-inch beams, rather than compression tests on 6 by 12-inch cylinders, as a measure of the strength of the concrete. The fact that the beams are cured under the same conditions as the pavement itself, whereas cylinders are usually sent to a laboratory and cured under laboratory conditions, doubtless has much to do with the greater confidence expressed in the accuracy of the beam test.

The greater economy of the beam tests was mentioned by several engineers, who point out that these tests are made in the field with small portable machines, while cylinders involve the expense of crating and shipping to a central laboratory.

Compression Tests Have Their Value

Compression tests on cylinders have much value, in spite of the general preference for beam tests. This point is emphasized by G. H. Henderson, chief engineer, Rhode Island State Board of Public Roads. "We think the beam tests are the most useful," he says, "but we have obtained a considerable amount of data (on concrete produced in various locations) from cylinders taken from the various jobs twice each week. Beams are ordinarily cured in the field, under the same conditions as the pavement, while the cylinders are brought into the moist-room as soon as possible and cured under laboratory conditions so as not to be affected by varying weather conditions and temperature changes. The results of compression tests of these cylinders have given us a chance to compare the value of aggregates from different sources."

Core Tests Found Useful

There is almost complete agreement that core tests are both necessary and desirable. The cores not only provide a check on the thickness of the pavement, but they supply an economical means of determining the compressive strength of the concrete actually placed in the pavement.

In Missouri cores are taken at approximate intervals of 200 feet. In New Jersey the practice is to take a core out of every 1,000 square yards of pavement, representing intervals of about 500 feet in an 18-foot pavement.

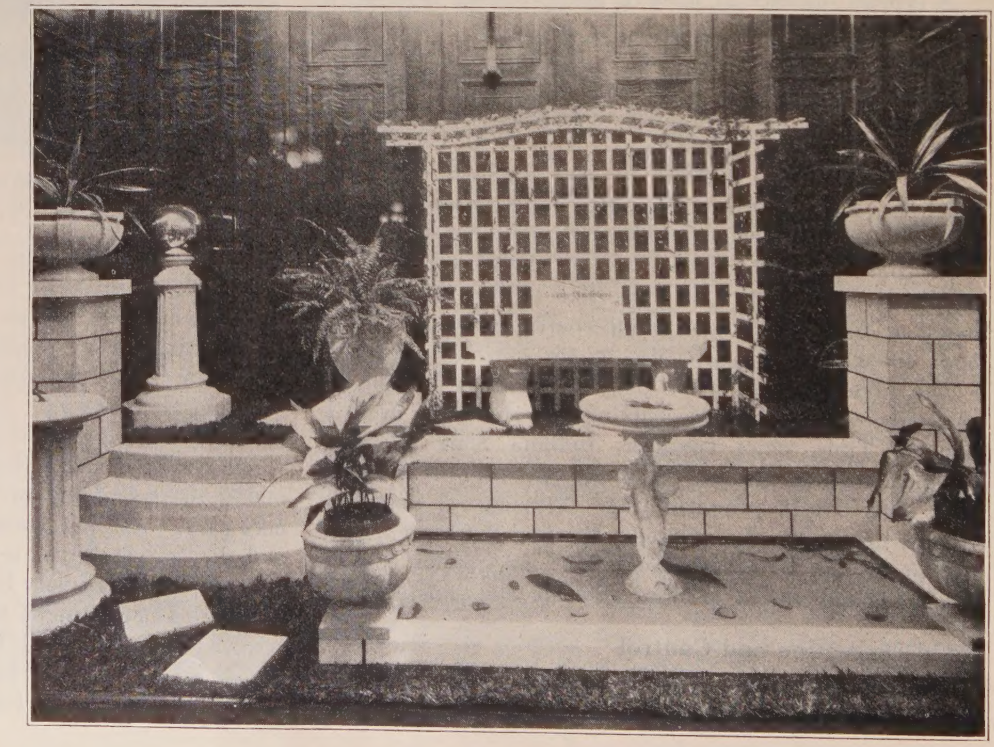
Summary

Summing up, it is found that the use of two sizes of coarse aggregate is on the increase, because of the better grading and greater density made possible; that proportioning by weight is practically the universal practice; that field inspection and control of mixtures are maintained at a high standard; and that beam and core tests are regarded as having the greatest value to highway engineers.

Cast Stone Display in Downtown Show Window

This attractive display of cast stone appeared in the show window of Wolf & Dessauer's department store in the downtown business district of Fort Wayne, Ind., during the celebration of "Achievement Week," organized to call attention to locally manufactured products.

The display here illustrated was that of the Acker Cement Products & Supply Co., of Fort Wayne. This representation of an ornamental garden, with cast stone work grouped around the central pool, attracted much attention. The pool, stocked with fish, was 3 ft. wide and 6 ft. long, and the bottom was covered with white sand.



Construction Methods Fit Problems on Large Generating Plant

Shutting Out Lake Water Was Biggest Excavating Problem—The Concreting Plant—Distribute Concrete Economically With Gasoline-Driven Buggies on Runways

By CHARLES C. MOODY
Engineer, Herlihy Mid-Continent Company, General Contractors, Chicago, Ill.

Here is the first of a series of three articles describing the construction of the second section of the great electric generating plant of the Chicago District Electric Generating Corporation, located on made land jutting into Lake Michigan near the Indiana-Illinois state line.

Form work, winter concreting, and the construction of intake and discharge tunnels will be described in the second article, and valuable construction cost data comprise the third article.

The halftone illustrations here shown are made from the only photographs of this work given out for publication. They were taken especially for "Concrete" for use in this series, and are not to be reproduced without specific permission.—The Editors.

JUST across the Illinois state line, in Indiana, and jutting one-half mile into Lake Michigan, is a strip of made land about three-quarters of a mile in length. This site was chosen a few years ago by the Chicago District Electric Generating Corporation, for an electric generating plant to supply power and light for the northern part of Indiana and a portion of Illinois. A few years from now will see on this site the largest electric generating plant in the world, from which will emanate current supplied by machines capable of turning out more than one million kilowatts.

This plant is being constructed in a series of five sections, the first of which has been completed, and the second section is now well on the way to completion.

The first section, housing machinery necessary for the production of about 208,000 kilowatts of electric energy, is now, to all practical purposes, being duplicated. The two new generating units will lie alongside the first, and will appear with the first as one building.

The Construction Site

Picture a plot of ground jutting out into Lake Michigan nearly one-quarter mile, and one-half of a mile in length. The north half will be occupied by the main building when all units are completed, and the south half by coal storage. At present the one unit, approximately 200 by 400 ft., stands out like a huge monument, rising nearly 150 ft., and topped by two immense stacks rising another hundred feet.

We see, however, but a small part of what this building represents. The immensity of the work is not in the part we see, but in that portion lying below grade, with its foundations either supported on piling or caissons, and

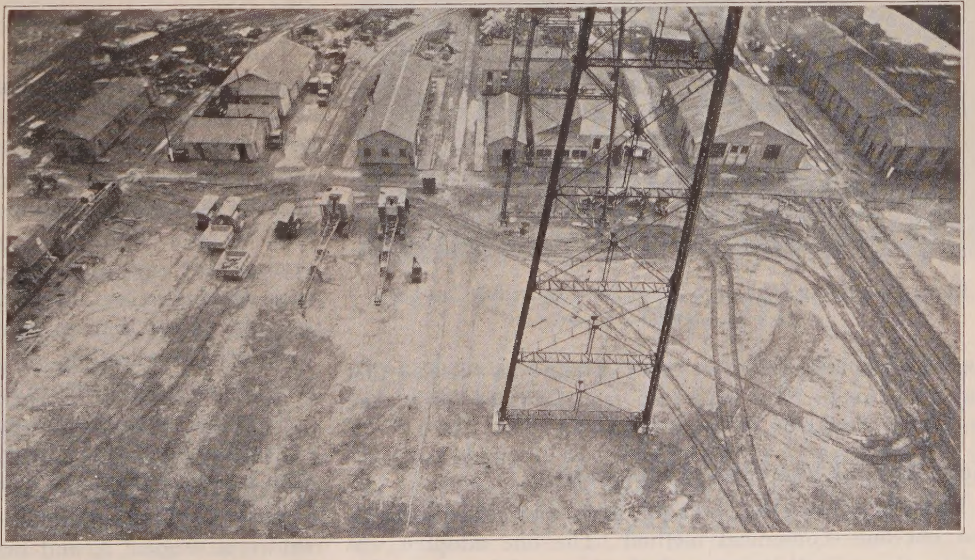


Figure 1. Striking view of construction site of large generating plant in Indiana, near the Illinois state line, taken just before excavating was started. Major units of excavating equipment lined up for action

the system of water tunnels that carry water to the plant and discharge back into the lake.

In one way the site for the new unit was ideal from a contractor's standpoint—a level stretch of sand with a delivery track alongside of one end, and stub tracks leading to and ending at the long side (see Figure 1), with plenty of room for the wastage of excavated sand within 700 ft. of the site, and a large area with plenty of trackage for the storage of building materials.

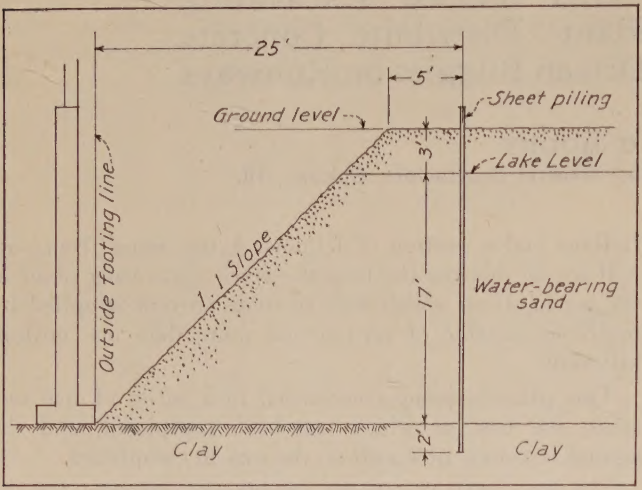


Figure 2. Showing how bracing of sheet piling was avoided

However, the surface of this land hid a menace that, if not properly handled, would prove a serious difficulty. Three feet below the present grade lay water, and it was not until about twenty feet below grade was reached that clay was found. This seventeen feet of water-laden sand had to be confined.

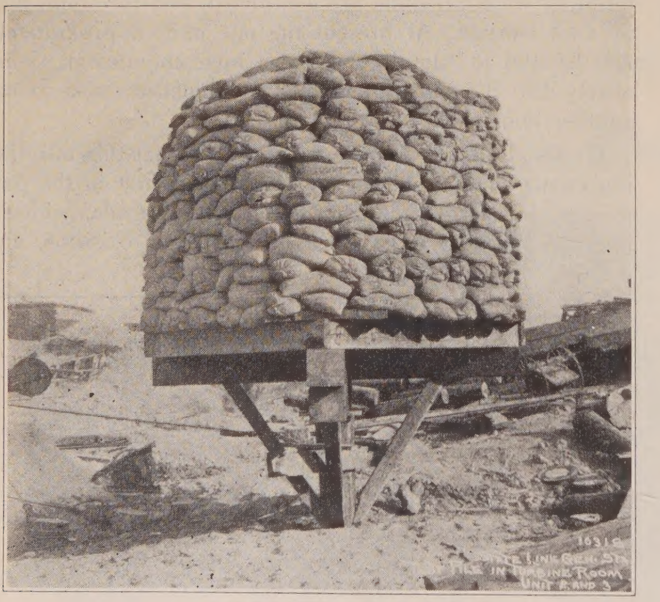


Figure 3. Forty tons of cement serving as test load for pile

How Ground Water Was Controlled

There were several ways to overcome this difficulty, and but one economical method. The one adopted was rather clever in that it saved shoring and bracing. The idea was to confine the water inside the area to be excavated and prevent more water from entering it. Therefore, 6-inch Wakefield sheathing was driven through the sand and at least two feet into clay. This sheathing followed the building lines, but was 25 ft. outside all footings, and a sufficient amount of sand was left in place alongside this sheathing to leave a 5-ft. berm at the top and a one-to-one slope to the footing lines. Due to this method no bracing was required inside the sheathing, as will be seen from Figure 2. This removed all danger of water from the general excavation, and, with the exception of footings and deeper pits within the building area, no other sheathing was necessary.

When the sheathing was completed, a steam shovel started excavating a hole for a sump, and a 6-in. centrifugal pump began operating. As the level of the water fell, more sand was taken out and finally the entire area was excavated to the required depths.

It is a difficult matter to put in wood sheathing that will be impervious to leakage, and, were it not for this fact, probably no pumps at all would have been required once the water had been removed. But at no time was it necessary to use more than two small diaphragm pumps after the bulk of water had been pumped out. These took care of seepage.

General excavation was carried on with the use of a steam shovel loading 8-yd. dump wagons, drawn by caterpillar tractors, working three shifts. The greatest quantity of excavation taken out and disposed of in 24 hours was about 3,000 cubic yards. The record of 189 loads in 8 hours was made, or somewhat more than 1,300 yards. At no time were more than three tractors employed to haul the wastage.

Caissons Have Double Lagging in Sand

While general excavation work was being carried on, the caissons were started and carried down to rock. The ordinary methods were used in the construction of the caissons, wood lagging being used entirely.

However, because of seepage through the main cofferdam, double sheathing had to be used above the clay level, and clay packed between. Air-driven spades were used in the clay and semi-hardpan.

Piling

Upward of 4,000 wood piles of varying length were used to support foundations and floors in this work, and in all cases a 4,800-lb. steam hammer was used, and all piles were driven to an average penetration of ¼ in.

In many locations longer piles had to be driven to conform to the uneven contour of the underlying hard ground, and, because of this fact, one could not determine within several feet just what length pile to use. The engineers then decided to use three lengths of piles and have longer cut-offs, rather than to drive more piles where one failed in desired penetration. In the long run this proved economical and eliminated loss in driving additional piles.

In order that there would be no uncertainty in risk of settlement of this piling, one pile was selected at random for the purpose of conducting a test.

This pile was prepared with a platform on top, as shown in Figure 3, and braces notched into the pile and to the platform to prevent tilting. Following this, a tack was driven into the pile and a series of readings taken with a level.

Then the platform was loaded very carefully with sacks of cement until the amount of about 40 tons was piled on it. After standing free for 14 days, readings were again taken and the result was "No Settlement."

Concrete Plant

In the preparation of mixing and placing concrete there are many things to be considered. Among the most important to be considered are the distance from raw materials to form work; method of placing in forms; and last, but not least, the total yardage to be placed. Upon the last item will depend just how much a contractor can afford to spend for his mixing equipment, and the method of depositing the concrete.

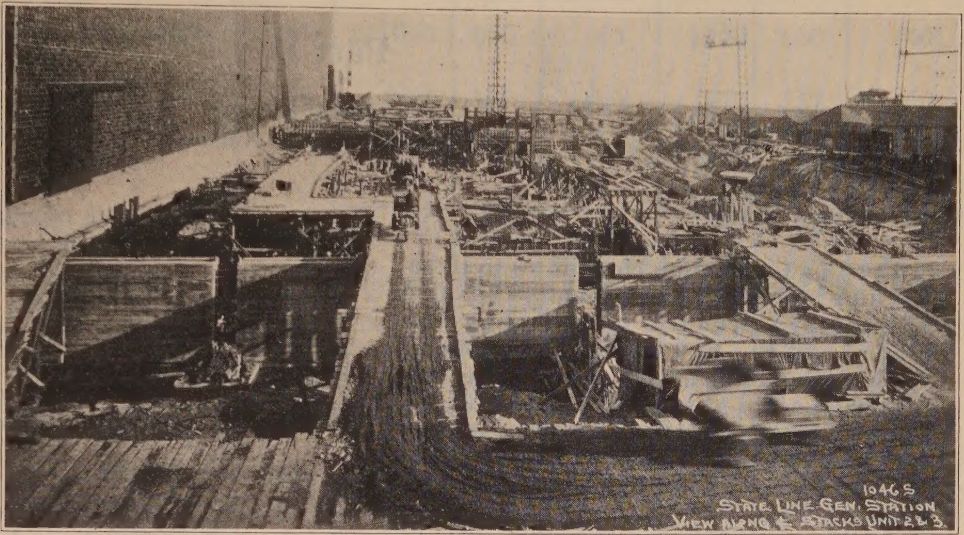


Figure 4. System of runways and delivery by gasoline-driven concrete buggies proved more economical than hoist-and-chute distribution

At the State Line Power House a total of approximately 30,000 cubic yards of concrete will eventually be placed in forms when the present units now under construction shall have been completed. Of the above amount, approximately 3,500 cubic yards was deposited in caissons, and 16,000 cubic yards in foundations and tunnels below grade. The balance is to be deposited in slabs both on ground and various floors above ground.

We, therefore, see about two-thirds of the bulk of all concrete below grade. This amount of concrete was deposited over an area of approximately 80,000 sq. ft., making the volume of concrete equivalent to an average depth of about 6 ft. over this area. This, of course, included caissons.

To use chutes and towers for the placing of this amount of concrete entailed a very heavy initial expense in the erection, handling, and removal of equipment. Also, job conditions prevented its use to advantage.

Because of successful previous experience, it was decided to use three-wheeled, gasoline-driven concrete buggies for depositing concrete, which, of course, entailed the building of runways. The cost of runways offset the cost of moving chutes with a distinct saving. The system of runways and one of the gasoline-driven buggies are shown in Figure 4. In the same figure, at the extreme right and above the top of the low buildings, the plant for mixing concrete may be seen.

The concreting plant consisted primarily of a yard batch mixer, an inundator, and a steel hopper for the aggregate, which loaded the mixer, in batches, by gravity.

The mixer was blocked off the ground to enable the three-wheeled concrete buggies to stand directly under the discharge chute. They held one mixer load of concrete. Cement was carried from the cement storage shed to the mixing plant by means of a 24-in. belt conveyor, which was run by the same motor that ran the mixer.

The aggregate hopper was loaded directly from cars or storage piles by means of a crane and clamshell bucket.

The entire job was laid out for a system of runways 12 ft. wide, to be used for the gasoline-driven buggies in conveying concrete. These runways were so laid out that from them the dump buggies could fill any form, or series of forms, by gravity.

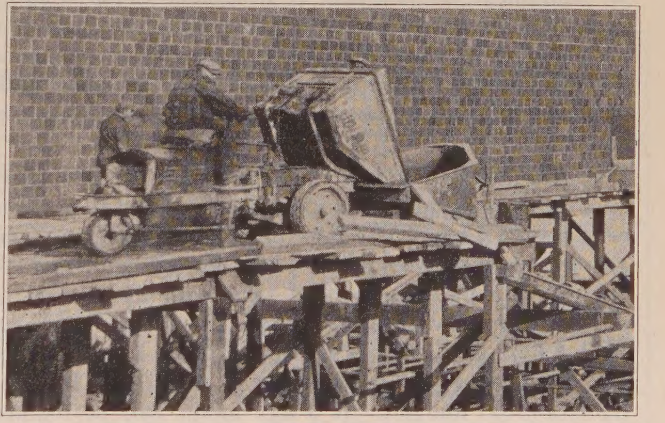


Figure 5. Buggies dumped into portable deck hoppers, placed wherever necessary

A small deck hopper was placed where necessary, and buggies dumped into them, thereby controlling the flow of concrete as shown in Figure 5. It was but a simple matter to fasten a deck hopper to a buggy, and thus pull it anywhere on the job for the next run of concreting.

(*To be continued*)

Profitable Manufacture of Concrete Building Units

Continuing Analysis of Economical Raw Material Handling Methods—Determining Fixed Costs—Comparison of Methods—Provision for Varying Annual Output

V—Handling and Storage of Raw Materials

Part II

By FRED A. SAGER
Consulting Industrial Engineer

Keeping production costs down to their absolute minimum is essential in the scheme of a products plant that makes money. As the first step in production, the handling and storage of raw materials deserve the closest scrutiny and that is the kind of attention they receive at the hands of Fred A. Sager, in this chapter of "Profitable Manufacture of Concrete Building Units."

After completing his analysis of this department in this chapter, Mr. Sager will go on to others, keeping the factor of economy always in mind.—The Editors.

(Continued from April Issue)

FOR the operation of unloading cars with elevator equipment, as sketched in Diagrams 7 and 8[1], it is necessary to consider the cost of the equipment used, and the resulting overhead charges, such as interest, depreciation and maintenance. Such costs must be included in the total cost of handling the materials and will be determined below.

In considering the direct operating costs of this operation, it is assumed that materials are received in dump cars, and flow by gravity into the receiving hopper. They are then delivered by feeder to bucket elevator, and discharged into the storage bins. The equipment estimated on has a capacity of 15 to 20 yds. of material per hour. With 5 by 8 in. buckets, 20 yds., or 30,000 lbs., of cinders can be handled per hour, or a car of 110,000 lbs. in 3 hours and 40 minutes. A 5 h.p. motor will be required to operate the equipment. It will take approximately 5 k.w. input or 20 k.w.h. for the operation, costing, at 8 cents per k.w.h., $1.60. With a charge of 5 hours' time for one man, or $3.75, the total operating cost is $5.35, or a cost of 4.85 cents per 1,000 lbs.

Crushing and Screening Costs

In the case of a cinder block plant, screening and crushing equipment will usually be required, and a 15 h.p. motor will be used for the operation. The time required will be the same as before—15 k.w. for 4 hours, or 60 k.w.h. at 8 cents, or a cost of $4.80. As attention has to be given at times to the crusher and screens as well as the elevator, labor is taken as 2 men for the period, or 8 labor hours at $6.00. The total cost of $10.80 amounts to 9.85 cents per 1,000 lbs. handled, crushed and screened.

Equipment Costs

For the purpose of determining the fixed or overhead costs in handling materials, the cost of the facilities will now be taken up.

With storage piles as shown in Diagram 6, the cost of an assumed 90 ft. of bin side 10 ft. high is taken at $175.00, on which the interest charge at 6 per cent is $10.50 per year, depreciation on the basis of a 20-year life is $8.75, and maintenance is $10.00 per year, making a total of $29.25 annually.

This total charged to the storage of the 10,200,000 lbs. of cinders required for the year's production, gives a charge of .287 cents per 1,000 lbs. handled. In this method of operation, cost will also be incurred for shovels, wheelbarrows or wheel carts, and runways. This cost would be of the same order as the above bin charge and would be most conveniently handled as a direct maintenance charge.

The total overhead charge for this operation is in the neighborhood of .5 cents per 1,000 lbs. handled, but is not included in the costs shown for this operation as Curves A in Diagram 9. The overhead in this case is so small as compared with the labor cost that it has been disregarded.

Table of Overhead Charges

In the case of the elevating, screening and crushing equipment shown in Diagrams 7 and 8, the costs of overhead charges have been set up in Table V. For the receiving hopper, the cost of which is for excavation and concrete, no depreciation and a low maintenance cost are figured. The life of the bins, which are estimated as built of wood, is taken at 20 years, or 5 per cent depreciation annually. For the elevated bins, a supporting structure of steel on concrete piers is figured. This portion might be given a lower depreciation rate. The elevator,

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[1] Page 19, April issue of Concrete.

Table V. Costs and Fixed Overhead Charges on Storage and Handling Facilities and Cost in Cents Per 1,000 Lbs. of Aggregate Handled With Varying Production

Costs and Fixed Overhead Charges on Storage and Handling Facilities.

Item	Bins on Ground			Bins Elevated			Bins Elevated with Screen and Crusher		
	Cost	Dep.	Maint	Cost	Dep.	Maint	Cost	Dep	Maint.
Receiving Hopper	$400		$10	$400		$10	$400		$10
Bins	400	$20	20	1000	$50	40	1000	$50	40
Elevator and Feed	800	160	144	840	167	150	840	167	150
Screen and Crusher							1150	230	204
Motor, Wiring & Shafting	260	18	26	260	18	26	500	34	50
Totals	$1860	$198	$200	$2500	$235	$226	$3890	$481	$454
Est. Min Values		93	50		125	60		195	104
Est Variable Portion		$105	$150		$110	$162		$286	$354
Summary of Overhead Cost									
Interest	$112			$150			$233		
Depreciation	198			235			481		
Maintenance	200			226			454		
Total	$510			$611			$1168		

screens and crusher are figured at a 5-year life if in reasonably full service.

For the estimated use of 8 hours a week, full depreciation and maintenance charges would not be applicable, and as shown in Table VI, the full charge is applied when handling 15,000,000 lbs., as would be the case with an

Table VI. Interest, Depreciation and Maintenance Costs on Equipment Used in Handling and Storing Aggregates

Interest, Depreciation and Maintenance Costs on Equipment used in Handling and Storing Aggregates.

Equiv 8" units made per year in thousands	Cinder Aggregate used per year in thousand pounds	Annual Costs on Equipment				Cost for Thousand Pounds of Aggregate Handled. in Cents.								
						Cinders stored in bins on ground			Cinders stored in elevated bins			Cinders screened and crushed, stored in elevated bins.		
		Int.	Dep.	Maint.	Total	Annual Charge	Add cost to move into bins. 4.85¢	Add cost to move into mixer. 5¢	Annual Charge	Add cost to move into bins. 4.85¢	Add cost to move into mixer. 2.5¢	Annual Charge	Add cost to move into bins. 9.85¢	Add cost to move into mixer. 2.5¢
50	1,500	$112	$103	$65	$280	18.65¢	23.50¢	28.50¢	23.42¢	28.27¢	30.77¢	39.40¢	49.25¢	51.75¢
100	3,000	112	114	80	306	10.20¢	15.05¢	20.05¢	13.00¢	17.85¢	20.35¢	21.85¢	31.90¢	34.40¢
150	4,500	112	124	95	331	7.35¢	12.20	17.20	9.30	14.15	16.65	15.80¢	25.65¢	28.15¢
200	6,000	112	135	110	357	5.95	10.60	15.60	7.43	12.28	14.78	13.08	22.93	25.43
250	7,500	112	145	125	382	5,10	9.95	14.95	6.31	11.16	13.66	11.30	21.15	23.65
300	9,000	112	153	140	405	4.50	9.35	14.35	5.55	10.40	12.90	10.15	20.00	22.50
350	10,500	112	106	165	443	4.21	9.06	14.03	5.02	9.87	12.37	9.30	19.15	21.65
400	12,000	112	177	170	469	3.90	8.75	13.75	4.68	9.53	12.03	8.65	18.50	21.00
450	13,500	112	188	185	485	3.59	8.44	13.44	4.32	9.17	11.67	8.16	18.01	20.51
500	15,000	112	198	200	510	3.40	8.25	13.25	4.07	8.92	11.42	7.80	17.65	20.15
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)

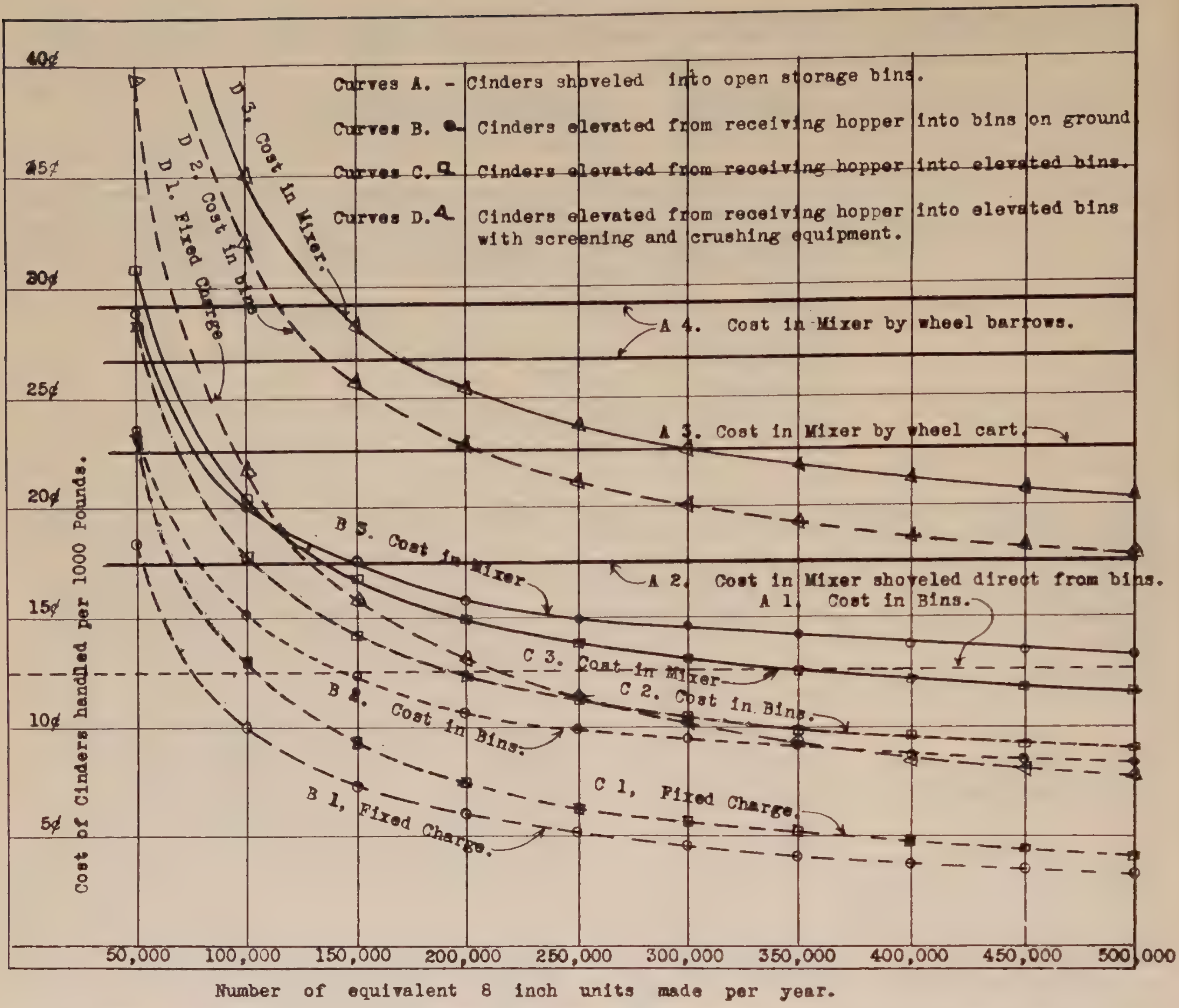

Diagram 9. Variation in cost of handling 1,000 lbs. of cinder aggregate with varying annual production

annual production of 500,000 units. The motors, wiring and shafting are given a 15-year life in full service. Maintenance for the mechanical equipment is figured at 1½ per cent a month and for the electrical equipment at 10 per cent a year. The total overhead charge per year for the three cases appears at the foot of Table V, as $510 with the bins on the ground, $611 with elevated bins, and $1,168 with elevated bins, screen and crusher. These costs apply to full service.

Varying Depreciation

For the purpose of developing the variations in costs of storage and handling materials that will occur with varying annual output, Table VI has been prepared, and in the first section of this table the estimated variation in depreciation and maintenance costs are shown for the case of elevating equipment with bins on the ground. For this purpose it is estimated that the minimum depreciation will be on a 20-year life basis, and is shown in amount in Table V, as $93 a year. This amount taken from the full depreciation of $198 leaves what is termed the variable portion of the depreciation, i. e., in Table VI the depreciation ranges downward from $198, with an annual output of 500,000 units, to $103, with an output of 50,000 units. In a similar way the maintenance costs are scaled down from the maximum of $200 to $65 for the smallest output shown. Similar estimates have been made for the other cases, but the detail, such as is shown in Columns (3), (4), (5), and (6) of Table VI, for the case with bins on the ground, is not included in the table. Only the final results are shown for those cases.

Following out the first case, shown in detail, Column (6) of Table VI shows the total estimated annual charge for interest, depreciation and maintenance for the case of bins on the ground. In Column (7) this cost is reduced to the cost of handling a 1,000 lbs., by dividing the annual cost [Column (7)] by the thousands of pounds handled during the year [Col. (2)]. The range in cost per 1,000 lbs. handled appearing in Column (7) clearly shows the mounting costs accompanying little use of expensive equipment.

Cost of Material in Bins

For the cost of the material in the bins, there must be added the direct operating cost shown in Table IV[2] as 4.85 cents a 1,000 lbs.

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[2] Page 18, April issue of CONCRETE.

That cost in bins appears in Column (8), Table VI. To get the total cost of handling to the mixer, there is added the cost of moving from storage to mixer, which, with bins on the ground, is the operation of shoveling down. This is figured in Table IV at 5 cents per 1,000 lbs. The total cost is found in Column (9), Table VI. Similar costs for the other two cases considered appear in Columns (10) to (15) in Table VI.

Curves Show Costs

For easy comparison these final figures have been plotted in chart form in Diagram 9, in which the solid line curves represent the entire handling cost from car to mixer for the conditions estimated. The cost in the bins is shown by the dotted curve and for Curves B, C and D, another dotted curve shows the fixed charge. If the cost to get the material in storage is considered alone, it appears that elevating equipment is not a matter of economy with the annual output below 150,000 units, at which point Curve A 1—cost of shoveling into bins—passes below Curve B 2—the cost with elevating equipment and bins on the ground. But if the total cost of getting material to the mixer is considered, the elevating equipment may be used with economy with as small an output as 50,000 units per year.

The costs shown as Curve A 2, for shoveling, may be realized in case the storage pile can be built up alongside the plant, to make it possible to shovel down into the mixer batch box the greater part of the time, which means that storage would have to be kept up. The best that can ordinarily be done, however, is indicated by Curve A 3, on which basis the cost of elevating machinery is warranted for production well under 100,000 units per year.

While the cost of the material in the bins is less for ground bins, the cost in the mixer is less for elevated bins for outputs above about 100,000 units. For lower output the higher fixed charge reverses the situation. As stated above, this analysis is set up as illustrative of the method of working out any specific case, where the rate of performance and labor and equipment costs are known.

Furthermore, after the first year of operation, the actual maintenance costs on equipment should be substituted for any estimated maintenance cost. As a matter of record, maintenance costs for a period of years are in hand. They show costs less than those on which Column (13) in Table VI are based, and it is probable that some plants develop higher maintenance costs. Likewise, the figures for depreciation for any given plant should be adjusted as time passes, and a more correct estimate of the life of the equipment, with the attention received in the given plant, can be made. But for the study of the layout for a new plant, such a plan may be well employed in making comparison of the economy of the various operating methods.

Thinks Subgrade No Serious Problem with Concrete Pavements

The following letter from Wm. E. Barker, of the highways and municipal bureau of the Portland Cement Association, refers to the article, "Where More Research Is Needed in Concrete Highway Work," printed on pages 33 and 34 of the April issue of CONCRETE.

In the article mentioned, reference is made to the general agreement among highway engineers regarding the need for more intensive studies of subgrade soils, drainage and frost action, and their relation to concrete pavements. Mr. Barker's letter follows:

"I have just read your April article on Highway Research.

"There is, just at present, a tendency among highway engineers to confuse the importance of subgrades to gravel, macadam and other flexible surfaces, with their importance to concrete. Because concrete forms a rigid surface it bridges minor inequalities and distributes loads to a much greater area, minimizing the effect of soils of poor supporting value. This has been found especially true for slabs more than 6 inches thick.

"The silts and other finely divided soils heave when frozen and may cause serious cracking. Fortunately, they usually occur in small pockets, so that they may be economically removed and replaced with good material. And when they occur in longer stretches, so that some length of slab is heaved equally, they do much less damage.

"The gumbos and adobe soils occurring in certain restricted areas, and which expand and contract greatly, are about the only other soils that bother concrete. These are commonly covered with a layer of granular material or weathered top soil, so that contraction or expansion in them is not transmitted to the concrete.

"In any study of the effect of subgrade on roadway surfaces erroneous conclusions will be reached unless the line between the effect on non-rigid and rigid pavements is sharply drawn and always observed.

"Yours very truly,
"WM. E. BARKER,
"Highways and Municipal Bureau."

Bureau of the Census Issues Construction Report

The United States Bureau of the Census has issued a mimeographed report on the construction census taken in 1930 under the direction of Alanson D. Morehouse, chief of the construction section. The report consists of a paper presented by Mr. Morehouse before the twentieth annual convention of the National Association of Builders' Exchanges, held at San Antonio, Texas, on February 17.

The bureau's analysis of the construction industry is expected to establish average costs for the component parts of the business, classified as to type and size of construction work carried on.

A Series on Metal Forms

A series of articles on the use of metal forms, to be illustrated with detailed drawings and photographs, will be started in the June issue of "Concrete," as first announced on page 44 of the April issue.

The manner in which such forms are assembled, erected and removed, how special widths of form units are employed at offsets, the type of wall ties used, and a number of other points of information, will be included in these articles.

Tandem Mixers Demonstrate Value on Missouri Road Work

How Mixers Were Operated—Amounted in Effect to Two Batches Being Mixed at Same Time—Record of Daily Runs Shows Work Speeded Up

ON concrete highway paving work in Dallas County, Missouri, in August, September and October, 1930, the contracting firm of Hoeffken Brothers, of Belleville, Illinois, made a successful experiment with the use of two mixers, working in tandem. The work was speeded up considerably, as the tabulation of daily runs discloses.

How Tandem Equipment Is Operated

The manner in which this equipment was operated is described in a report by C. T. McGinley, of the Bureau of Public Roads.

Two cranes and one set of bins with batch scales were used at the stock-pile. One crane was used for gravel and one for sand. The trucks were driven through under the bins, eliminating time wasted by turning and backing.

Two 27-E mixers of Koehring manufacture, working in tandem, were employed on the paving. The mixers worked independently. All material and water were mixed in the first mixer for more than half a minute and discharged into the bucket. The concrete was dumped from the bucket into the skip of the second mixer. A timber was bolted across the end of the skip to prevent overflow of the concrete. The concrete was then mixed the balance of the time by the second mixer and discharged by a bucket.

One Lakewood finishing machine with one operator was able to keep up with the paver. The screed and tamper were used the first time over and the screed and belt for the final trip. The finishing machine operated from the outer rail of the dual forms. A premolded 2½ by ⅜-in. bituminous felt center strip and a similar premolded transverse contraction joint, spaced 40 feet apart on fills and 20 feet apart in cuts, were laid with a Flex-plane machine. One operator did this work satisfactorily.

A longitudinal "bull float" was used from a rolling bridge, and the slab was floated, checked with 10-ft. straight-edges, and belted before the monolithic lip was built.

A 3-in. form was clipped to the side forms and the lip curb built by hand with a steel "mule" and the surface finished with a brush to resemble the finish of the slab. The pavement and lip were covered with wet burlap and kept damp until the following morning, when calcium chloride was spread on the surface.

The Working Crew

The force around the mixer consisted of one foreman and four men maintaining fine subgrade and lining forms and two men operating the turntable for trucks. The first mixer had two operators, one for the skip and one to swing the boom over and away from the skip of the second mixer. One operator handled the second mixer. There were ten men in the puddle, one finishing machine operator, one Flex-plane operator, two men using the longitudinal float, two men on straight-edges and belt, and one foreman in charge. One foreman and ten men were employed in constructing the lip curb, four men worked behind the edging slab and the transverse joints, covering with burlap and sprinkling.

RECORD OF TANDEM MIXER RUNS, DALLAS COUNTY, MISSOURI

Date	Day's Run, in Lin. Ft.	Hours Worked	No. of Batch Trucks	No. of Cement Trucks	Average Run in Lin. Ft. Per Hour	Average Haul, in Miles
8/13	1337	9:40	51	5	138	4.87
8/14	1375	9:35	51	5	144	4.61
8/18	743	6:45	49	6	110	4.41
8/19	990	6:45	48	6	147	4.25
8/20	1882	12:35	48	8	150	3.98
8/21	1712	12:40	48	8	135	3.64
8/22	1759	13:10	48	8	133	3.32
8/25	1038	7:20	48	8	142	3.05
8/27	1807	12:20	48	8	146	2.78
8/28	1742	13:00	49	9	134	2.44
8/29	1284	9:20	37	9	137	2.15
8/30	501	3:40	35	10	136	1.98
8/31	1512	11:15	34	10	134	1.79
9/1	1731	12:30	24	10	138	1.48
9/2	1165	9:15	28	10	125	1.20
9/3	522	3:50	26	10	136	1.04
9/3	1017	6:15	26	10	163	.90
9/4	1443	10:30	20	10	137	.67
9/5	980	6:30	20	10	151	.44
9/13	845	5:45	10	10	147	.27
9/14	793	6:00	10	5	132	.10
9/20	164	2:30	33	3	66	2.05
9/21	1484	11:25	33	7	130	1.90
9/22	1679	11:40	33	7	144	1.60
9/23	1475	10:45	31	8	137	1.30
9/24	900	6:15	29	8	144	1.04
9/26	1750	12:00	25	10	146	.79
9/27	1195	10:00	26	10	120	.51
9/28	909	7:30	13	10	129	.36
9/28	567	4:00	8	10	142	.15
10/1	1255	9:35	30	10	131	2.70
10/2	1533	11:00	35	10	139	2.44
10/3	1590	10:45	35	9	148	2.14
10/4	1547	10:15	31	10	150	1.84
10/5	1478	10:00	28	10	148	1.56
10/9	563	3:45	33	10	150	1.37
10/10	915	6:00	26	10	153	1.23
10/11	1334	9:45	18	10	136	1.00
10/12	1128	9:00	22	10	125	.77
10/13	1736	11:30	24	10	151	.50
10/14	1462	10:30	18	10	130	.20
10/18	1022	10:00	35	10	102	2.94
10/19	1200	11:00	34	5	109	2.73
10/20	1224	10:30	30	5	116	2.50
10/21	826	7:15	26	5	114	2.30
10/25	691	7:00	21	5	99	2.17
10/26	684	6:30	21	5	105	2.05

The paving work here described was placed under the direction of T. H. Cutler, chief engineer of the Missouri State Highway Department.

EDITORIAL

Making Use of Large-Size Aggregate

HIGHWAY engineers seem to be taking the lead in utilizing the advantages of large-size coarse aggregate, although in the construction of dams the same practice prevails.

In letters addressed to "Concrete" a number of highway engineers have reported favorable experience with large aggregate. In most instances the coarse material is separated into two sizes—for example, from ¼ to 1½ inches and from 1½ to 3 inches.

One advantage found in the use of two sizes of coarse material is the better grading, for this practice insures the presence of all particle sizes between the smallest and the largest size limits. This condition, in turn, insures a low void content, which leads directly to the second advantage of greater density along with increased yield.

In cases where aggregate from local pits is employed on important construction work, good practice requires the pit-run material to be screened and then recombined in the proper proportions between the fine and the coarse. Too often, however, the sizes above 2 inches are discarded. This is clearly a wasteful practice, since the larger sizes can be employed to advantage in all parts of the structure that are not heavily reinforced.

An Undeveloped Field in Sub-Contracting

RECENTLY an officer of a well-known construction company told a representative of "Concrete" that the estimating of form work still remains a bugbear with 90 per cent of the contractors. Most of them, he said, do not know what their form costs are, and few of them understand how to lay out their form work or how to organize their form crews so as to employ them to the best advantage.

Here is a promising activity that, with a few exceptions, has not been cultivated. If concrete form work remains as the most uncertain element with the large majority of contractors, this fact suggests an opportunity to build up a sub-contracting business specializing in this field. If form work is a bugbear with the general run of contractors, they should be in a willing mood to sublet this part of the work.

An organization specializing in form work must be equipped to plan and design the work in advance and to take full advantage of the use of standardized units and convenient methods of assembly. Working crews must be in charge of experienced foremen.

Several instances have recently been noted where enterprising young men have developed a profitable sub-contracting business of this character. The field is still wide open in many cities, and it is a field well worth study and investigation.

Cast Stone—An Aggressive Industry

THE annual meeting of the Cast Stone Institute in Cleveland this month marks an important milestone in the history of this aggressive young industry.

The convention program itself is an ambitious one, and it reflects quite accurately the nature of the problems for which the industry, represented by the Institute, has set out to find solutions. Speakers of national prominence will discuss accomplishments in research and improvements in manufacturing processes having far-reaching importance.

Notable progress has been made since the annual meeting of last year in establishing more general recognition for standards of quality in cast stone, and in bringing this material to the attention of architects by means of details and other data placed in their hands.

With an enviable record of past achievement to the credit of the Institute, and with a commendable program of constructive work scheduled for the coming twelve months, it is difficult to see how any manufacturer of cast stone can afford to withhold his co-operation and support.

Let's Have More Grade Separation

THE advent of spring and warm weather have once more demonstrated the urgent need for the separation of grades between main highways, and between highways and railways, in the environs of large cities.

Expenditures for grade separation accomplish more toward the relief of traffic congestion than equal amounts spent for any other purpose. The slow rate at which such separation is being accomplished around some of our most populous centers raises the question as to whether the heads of state and county highway departments fully realize this fact.

The untangling of traffic jams on highways already built is of even greater importance than the addition of new mileage.

PROGRESS—In a Page

Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups.

Requirements for Fire Resistance in Buildings

THE Building Code Committee of the United States Department of Commerce has issued the sixth of its reports dealing with building construction practice, in the form of a 58-page booklet entitled "Recommended Minimum Requirements for Fire Resistance in Buildings."

The first 18 pages contain the introduction and the recommended provisions for insertion in building codes, and the remaining 40 pages contain the supporting data on which the recommendations are based.

In this report buildings are grouped into the following six types of construction:

Type 1. Fully protected.
Type 2. Protected.
Type 3. Heavy timber.
Type 4. Masonry wall and joist.
Type 5. Wood frame.
Type 6. Unprotected metal.

Types of construction are defined, and the degree of fire resistance, expressed in hours, is established for walls, partitions, floors and structural members in the different types.

In the appendix numerous forms and materials of construction are listed as constituting various degrees of fire resistance, ranging from 4-hour to 1-hour protection. Monolithic concrete and concrete units are given recognition as suitable materials for walls (including party, fire and fire division walls), partitions, floors, columns and column fireproofing.

An abstract of the report is soon to be published in CONCRETE. Copies of the booklet may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents each.

Suggest Technical Assistant for Committee C-1 on Cement

AT a meeting in New York City recently, Committee C-1 on Cement of the American Society for Testing Materials took another forward step in improving its efficiency of operation and its service to cement users. While the committee is a large one and composed of representatives of nearly all important technical groups who use or make portland cement, it is recognized that this material is so widely used and its uses are so diversified that it is almost impossible to keep in touch with the views and experiences of cement users through its membership. The committee therefore has suggested to the society, for approval, the plan of employing a technical assistant to the chairman of the committee, whose duty, among others, would be to keep in touch with developments in cement and concrete in the different fields of its use.

Bedding and Backfilling Reinforced Concrete Pipe

THE American Concrete Pipe Association, 33 West Grand Avenue, Chicago, Illinois, has issued a mimeograph under the title of "Recommended Practice for Bedding and Backfilling Reinforced Concrete Pipe."

The mimeograph, which was presented for discussion at the annual meeting of the A.C.P.A., held in Chicago on February 23 and 24, offers a recommended practice based on examinations and studies of a number of concrete pipe installations. The pipe lines examined had been installed from one to twenty-two years, in a number of cities throughout the United States and Canada, and represented practically every type of laying conditions.

Specifications for Terrazzo Floors Presented at Convention

STANDARD specifications for laying terrazzo floors were presented for adoption at the annual meeting of the National Terrazzo and Mosaic Association, being held in Atlanta, Georgia, as we go to press with this issue. It was expected that the specifications will be accorded formal adoption during the convention.

This standard has been developed as the result of several years of effort, by a well qualified committee representing all sections of the country. It is hoped that the new standard may win general acceptance, in order that practice may become uniform.

As soon as the specifications can be published, copies may be obtained by addressing the National Terrazzo and Mosaic Association, 809 St. Paul Avenue, Milwaukee, Wisconsin.

Concrete Building Block and Tile Manufacturing Practice

THE "Proposed Recommended Practice for the Manufacture of Concrete Building Block and Tile" offered by Committee 708 of the American Concrete Institute appears in the April *Journal* of that organization.

The recommendations are intended primarily as aids to manufacturers having plants with a daily production of 500 units, or more, although much that is in the report will be of value to the proprietors of smaller products plants.

In addition to the mention of recent developments in manufacturing procedure and in the use of porous aggregates, the report gives considerable attention to plant layouts. There are several illustrations of curing installations and a diagrammatic plant layout.

Channel Piers in Suisun Bay Bridge Placed by Unusual Methods

Build Sand Island on Site of Each Pier—Steel Cutting Edge Assists Sinking of Concrete Caissons—Design of Concrete Mixtures Tabulated

By C. R. HARDING
Assistant to President, Southern Pacific Company, San Francisco, Calif.

The unusual methods employed for the first time in building eight massive channel piers for the Suisun Bay bridge of the Southern Pacific Railway are described in this concluding installment of Mr. Harding's story.

The quality of the concrete obtained provides definite proof that the methods employed were thoroughly sound.—The Editors.

(Concluded from the April issue)

OF the eleven main bridge piers of the Suisun Bay bridge, three were constructed by the well-known open cofferdam method.

The cofferdams were built of deep arch steel sheet piling driven in a single row through the overlying material into the bedrock. For two of these cofferdams the water was but 25 feet deep and no unusual features were developed in the pier construction, which followed the procedure used in building the small pedestal piers except that steel sheet piling was used instead of wood.

The third pier footing, however, was built at a depth of 58 feet below high water, an exceptional depth for the use of a single row of steel sheet piling.

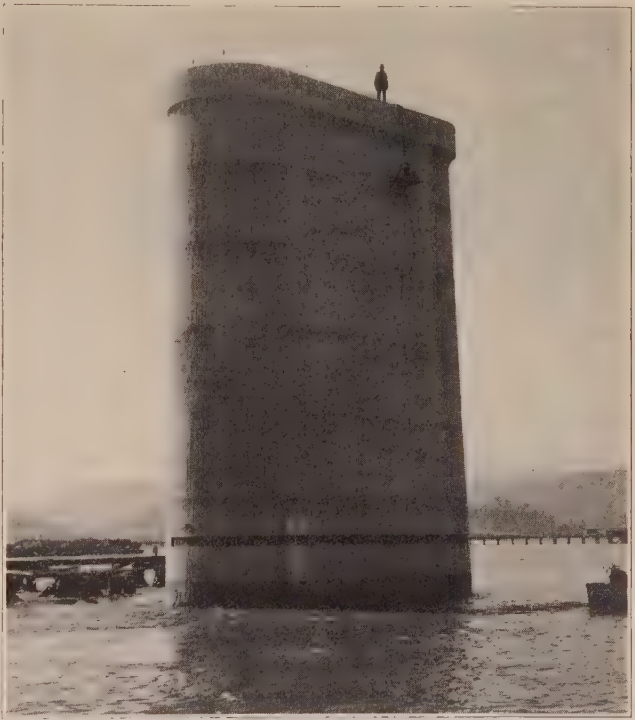
The pier shaft is 58 feet high from foundation block to bridge seat, with rounded ends on up- and downstream faces, the sides battered 1 in 24 and the ends 1 in 48. The shaft is reinforced with steel rods which are spliced to the bars in the foundation block to form a continuously reinforced concrete pier from bedrock to bridge seat, resistant to earthquake tremors of an assumed intensity, the steel used amounting to 21 lbs. to each cubic yard in the entire pier.

Concrete Mix in Cofferdam Piers and Tests of Samples

The normal tidal range in Suisun Bay at the bridge site is about 6.5 feet, and to protect the portion of the pier shaft alternately wet and dry from the action of the salt water, facing with granite slabs was given consideration.

Tests, however, of a dense concrete secured by the use of finely ground cement, to which was added diatomaceous silica, indicated high resistance to the action of saline waters; and, consequently, the 14 feet of pier shafts between elevations minus 4 and plus 10 were built with a concrete mix of 1-2-3, by volume, with 6.5 sacks of cement (3 lbs. of diatomaceous silica in each) to the cubic yard and 5.25 gallons of water per sack of cement.

The proportions, the cement factor, gallons of water per sack of cement, and compressive strengths, of the concrete in this and other parts of these piers are shown in Table II.



Shaft of a completed pier

Floating Mixing Plant of Large Capacity

For the construction of the main piers, sacked cement, crushed gravel and sand were delivered at each pier site on barges, and for the concreting operations a modern floating mixing plant was constructed which was moved from pier to pier as required.

This plant had a capacity of 60 cubic yards per hour, based on a 2-minute mix, and consisted of a 100-foot wooden hoisting tower with bucket and chutes, built up on the end of a large barge. The barge carried a two-compartment bunker for the aggregates, a weighing

TABLE II—SUMMARY OF CONCRETE MIXTURES AND STRENGTHS IN MAIN PIERS

Location	Proportions, by weight, except as noted	Sacks of cement per cu. yd. of concrete	Gallons of water per sack of cement	Average compressive strength, lb. per sq. in. 7 days	28 days	90 days
Main cofferdam piers, concrete placed in dry:						
(1) Lower 5 ft. of foundation block	1-2.2-4.2	5.50	6.50	2,060	3,250	- - -
(2) Remainder of pier, except shaft between elev. —4.0 and +10.0, and except bridge seat	1-2.52-4.39	5.04	6.78	2,050	3,150	3,900
(3) Pier shaft between elev. —4.0 and +10.0[1]	1-2-3 (by volume)	6.50	5.25	2,700	3,530	4,570
(4) Bridge seat, above undercoping	1-2.28-3.76	5.73	6.00	2,060	3,250	- - -
Eight main channel piers:						
(1) Caisson walls, and pier shafts except between elev. —4.0 and +10.0, and except bridge seat	1-2.52-4.39	5.04	6.78	2,050	3,150	4,300 (120 da.)
(2) Lower 15 ft. of dredging wells	1-1.82-2.91	7.00	5.06	2,220	3,680	4,750
(3) Remainder of dredging wells, and distributing block	1-2.46-4.18	5.17	6.53	2,060	3,180	4,030 (60 da.)
(4) Pier shaft between elev. —4.0 and +10.0	1-2-3 (by volume)	6.45	5.53	2,070	3,530	3,940
(5) Bridge seat, above undercoping	1-2.28-3.76	5.73	6.00	2,060	3,240	------

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[1] Cement used in this part of the pier shaft was a finely ground cement, with 3 lbs. of diatomaceous silica added to each sack.

batcher, a two-cubic-yard stationary mixer, water control and automatic signaling devices.

The sacked cement was taken from an endless belt conveyor which elevated it from the materials barge, the belt delivered it to a roller conveyor on the mixing barge, and the cement was dumped by hand into the mixer. The sand and gravel were hoisted in 1¼-yard clamshell buckets from the materials barges to the bunker. Fresh water was supplied from the south shore through a pipe line which was tapped at each pier site.

Open Dredging Method for Eight Main Channel Piers

Eight of the main piers were constructed at water depths of from 115 to 143 feet, considered impracticable for construction by any scheme except that of the open dredging method.

The procedure adopted is a combination of open dredging and cofferdam construction in which a reinforced concrete caisson was sunk to bedrock to form the foundation block, the top of this block being fixed at elevation minus 20.

Dredging through wells of caisson

From this underwater level a temporary timber cofferdam bolted to and sunk with the concrete caisson would afford a working chamber which was unwatered and the pier shaft concrete placed in the dry in forms within the chamber.

Temporary Sand Island for Caisson Construction

Construction engineers are familiar with the hazards and difficulty of sinking a floating caisson and landing it safely in correct location. To avoid such risks the contractors for this substructure developed and adopted a scheme which has never been used for such large piers.

This consisted in constructing first on each pier site a "sand island" in a cylindrical steel container, the interior dimensions being large enough to contain the rectangular foundation block or caisson. Upon the surface of the sand the caisson's steel cutting edge was set up in exact location for the pier, forms for the concrete caisson erected, reinforcing steel placed as called for in the plans and all concrete deposited in the dry.

As the sinking through the sand progressed it was found possible to control the position of the caisson at all times with a gratifying degree of accuracy.

Timber Working Platform Surrounds Steel Cylinders

To serve as falsework, during the construction of the piers, Douglas fir piles 95 to 125 feet long were driven in a double row, capped, framed and well braced to form an octagonal platform with an open center, the inner edge of each side tangent to the circumference of a circle 85 feet in diameter. At the south side seven piles were driven to form a foundation for a stiff-leg derrick.

On the middle of each side, a steel winch frame 44 feet high was set up, each frame rigged with block and tackle and hand winch for lowering or raising the steel cylinder.

Steel Cylinder Assembled and Lowered to Stable Position

On suspender beams projecting inward from this platform a steel cylinder 81 feet in diameter, fabricated in 8 segments to the circle, each ring 10 feet high, was assembled until a vertical height of 30 feet was bolted up.

It was then lowered into the water by means of simultaneous operation of the eight hand winches and temporarily bolted to the steel suspender beams located on top of the working platform.

Additional sections were bolted to the cylinder and lowered until the shell entered the mud and came to a position of stability where no further sinking took place. The heights of cylinders used varied from 60 feet to 110 feet, depending on depths of water and soft mud overlying the bedrock. In some cases it was necessary to assist sinking by means of water jets.

Steel Cylinders Filled with Sand

Sand was dredged from the bay bottom at a point about one-half mile upstream, barged to the site and placed in the cylinders with clamshell buckets.

The shell was filled with the sand to a level slightly above low water, excess water pumped out of the cylinder, and the top of the sand kept dry for a working platform by continuous pumping.

From 8,500 to 18,000 cubic yards of sand was required to form each of these artificial "sand islands."

Erecting Cutting Edge on Sand Island

The material overlying the bedrock was in some cases very dense, with the possibility of containing embedded boulders or timber. To facilitate sinking through these hard strata the bottom of the caisson was built of steel plates, and the exterior walls made "V"-shaped to form a cutting edge.

This cutting edge was filled with reinforced concrete and formed a steel-shod shoe which, with the immense weight of the pier above it, penetrated the softer rock strata and thus seated the foundation block of the piers firmly in place.

This steel framework, weighing 50 tons, was assembled on the "sand island" in precise location, as indicated by instrument men from the triangulation stations, and riveted together ready for erection of the forms for the concrete caisson.

For the two-lift span piers the exterior dimensions of the cutting edge are 40 feet by 60 feet and for the other six piers 38 feet by 60 feet. There were six dredging wells in each caisson 10 ft. 6 in. by 11 ft. 8 in., the partition walls between being 6 ft. thick and the exterior walls 6 ft. 6 in. thick.

All of these walls are heavily reinforced with vertical and horizontal steel rods tied together at intersections and spliced at joints to make the reinforcement continuous throughout the entire pier and provide resistance to shattering of the concrete by earthquake tremors.

Placing Concrete and Sinking Caisson

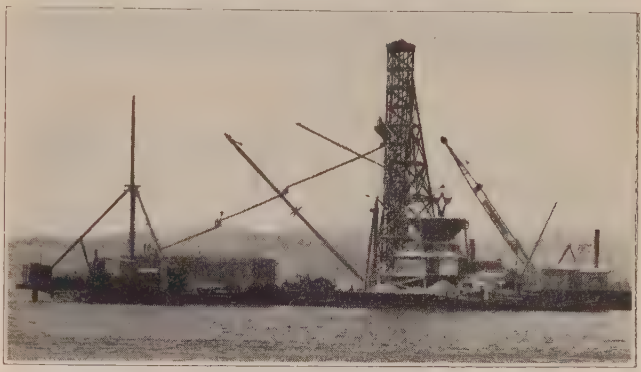
Removable steel panel forms for the exterior and steel box forms for the dredging wells were erected, and after depositing each 10-foot lift of concrete they were loosened and raised for the next lift. When the caisson had been built up to a height of 25 feet on the "sand island," clamshell buckets were brought into operation, lowered into the dredging wells and the sand dug out and loaded on barges for use at other piers. Excavation of the sand under the caisson caused the mass of concrete to sink. By careful alternation of dredging operations from one well to another the top of the caisson was kept nearly level at all times.

Alternate concreting and sinking of the caisson in 10-foot lifts proceeded on a three-day cycle, one day for erecting forms and placing reinforcing steel, another day for depositing the 525 cubic yards of concrete in the 10-foot lift, and the third day for setting of the concrete to a proper strength to permit stripping of the forms and dredging of the sand, which was usually done at night so that the caisson would be in position for erection of forms the next morning.

After a sufficient height of caisson had been built to reach from elevation minus 20 to bedrock, this distance having been determined from jet soundings in the four-corner dredging wells, which also gave the slope of the bedrock, the top of the exterior wall was made ready for attaching a rectangular timber cofferdam which, when the caisson landed on bedrock, extended above high water line.

The top ten feet of the caisson had only this three-foot thick reinforced wall around the outside, with no center walls, thus forming a recess in the top of the caisson which was later filled with concrete to form a distributing block.

After constructing this cofferdam, sinking of the caisson was resumed by continuous dredging until it landed on bedrock. At times, when the caisson was apparently hung up, it became necessary to explode small charges of dynamite below the cutting edge to loosen the hard material and allow sinking to continue.



Floating concreting plant in operation

Diver Gives Positive Assurance of Adequate Foundation

When the clamshell bucket scraped the bedrock and brought up no more material, a diver, experienced in deep sea diving, descended to the bottom of each dredging well, in water depths of from 100 to 143 feet, and examined the bedrock, reporting by telephone to the engineers above the relation of the cutting edge to the rock surface. He brought up samples of rock for inspection.

It was found that the cutting edge penetrated high points of the bedrock to a depth of two or three feet, and in no case was the rock surface out of level enough to make the landing precarious.

Tremie Concrete for Dredging Wells

After approval by the engineers, the dredging wells were filled with tremie concrete deposited through a 12-inch diameter pipe.

At no time during the concreting of a dredging well was the pipe permitted to be empty of concrete, and during the entire job of depositing 20,000 cubic yards of concrete by tremie in the dredging wells, no charges were lost due to the withdrawing of the pipe from the concrete.

This tremie concrete was keyed to the caisson by small horizontal recesses left in the walls of the dredging wells.

Diver coming up after investigation of bedrock

When all six dredging wells had been concreted the cofferdam was unwatered and the very small amount of laitance that had formed was removed.

Concreting Distributing Block Completes Foundation of Pier

The recess in the top ten feet of the caisson above the six dredging wells and their partition walls was now free for placing the steel reinforcement and concrete for the so-called distributing block, and this completed the foundation block to elevation minus 20. At this level the pier shaft began, with a cross-section much smaller than the footing block, thus leaving a horizontal shelf which was later made use of for supporting erection members of the steel superstructure.

Construction of Pier Shaft

Within the cofferdam the wood forms for the rounded ends and the steel panel forms for the flat parallel sides of the pier shaft were set up, steel reinforcing rods were placed in proper position after splicing to rods projecting from the distributing block, and concrete was deposited in 10-foot lifts until the pier shaft was well above the high water line.

The cables holding the timber cofferdam down to the foundation block were then released, and the sections were unbolted and stored for use on other piers.

Construction of the pier shaft, in 10-foot lifts, was then continued upward to completion at the final elevation of the bridge seat.

Concrete Mix and Tests of Samples

In the various parts of the eight main channel piers the proportions, the cement factor, gallons of water per sack of cement, and the compressive strengths, were as shown in Table II.

The heights of the eight main channel piers varied from 130 feet to 206 feet from bedrock to bridge seats, containing for the tallest pier 11,828 cubic yards of concrete, 175 tons of steel rods for reinforcement and 50 tons of structural steel in the cutting edge. For the pier 130 feet in height 9,190 cubic yards of concrete was used and 138 tons of steel rods, and 49 tons of structural steel for the cutting edge.

LARGE READY-MIXED PLANT OPERATED BY ONE MAN

Can you picture in your mind a plant for the production of ready-mixed concrete so thoroughly equipped that the entire plant is operated by one man?

This man weighs the aggregates and cement, charges the 3-yard mixer, controls the water content, heats the water during cold weather, and pushes the buttons that set the aggregate and cement conveyors in motion; and he has produced as much as 600 cu. yd. of concrete in a 10-hour day.

The June issue of "Concrete" will contain a detailed description of this well equipped and efficiently operated plant.

Acknowledgments

The bridge project was constructed under the direct supervision of the writer and W. H. Kirkbride, engineer of maintenance of way, assisted by G. W. Rear, engineer of bridges. All field work was in charge of H. I. Benjamin, assistant engineer of bridges, and the designs were checked by S. A. Roake, chief designer.

For the preliminary work Ralph Modjeski and Moran & Proctor were employed as consulting engineers. The vertical lift span was designed by Waddell & Hardesty, consulting engineers. The contractor for the concrete substructure was Siems, Helmers & Schaffner.

Coming Conventions

May 11-12—Cast Stone Institute, annual convention. Hotel Cleveland, Cleveland, Ohio.

May 12-16—National Fire Protection Association, annual meeting. Toronto, Ontario, Canada.

May 15-16—American Road Builders' Association, annual meetings. National Press Building, Washington, D. C.

May 21-22—National Concrete Burial Vault Association, annual meeting. State Fair Grounds, Columbus, Ohio.

June 3-4—National Lime Association, thirteenth annual convention. White Sulphur Springs, West Virginia.

June 22-26 — American Society for Testing Materials, annual meeting. Stevens Hotel, Chicago, Illinois.

Sell Concrete Tile in Competition With Clay Brick

Build Up Confidence in Product—Comparing Concrete Tile with Clay Brick on Quality Basis—Ratio of Labor Costs—Getting Increased Share of Business

By **NOLAN BROWNE**
Vice-President, Penniman Concrete and Material Co., Dallas, Texas

THE writer had been directly interested in the promotion and use of concrete masonry for a considerable period, when four years ago our company entered the manufacturing field and direct sale of light-weight, hollow concrete tile. The principal units are nominally 5¼ in. high by 8 in. wide by 12 in. long, and for partitions, 5¼ by 4 by 12. A complete assortment of fractional sizes is made in both the 8-in. and 4-in. widths and also special jamb tile and "beam" tile. Standard 5¼ by 8 by 12-in. two-core units weigh 18.6 lb. and have a minimum wall thickness of 1 in. at the bottom, increasing toward the top and terminating in a wide, flaring flange for the better reception of mortar. This flare on the middle web forms a very excellent hand-hold. Cores of special design prepared by ourselves are used.

Note particularly the 5¼-in. height. Because of the narrowness of the bottoms of the tile walls and their cutting effect, it was frequently difficult to maintain a 5½-in. course height, which is customary in our territory, when using really workable mortar and a 5-in. tile. After considerable field investigation, we settled upon 5¼ in. as the height which gave the proper course with the least amount of conscious effort on the part of the mason. We believe this to be progressive merchandising and that it is this sort of co-operation on our part that has created a feeling of friendship for the product among masons.

Building Up Confidence

One of our earliest decisions was that a trade name would be beneficial in acquainting builders with our product and holding it in their attention. The name "Wall-'Crete" was chosen, and, because of competition, it was copyrighted.

Confidence in Wall'Crete is steadily built up by getting every possible prospect, architect or purchaser, to visit our plant in order that we may show him the extreme care with which we make a product too often thought of as a bulky, carelessly made and rather non-uniform material. The laboratory and weight-batching equipment are given particular emphasis on such occasions. Many tests have been made by the city building inspector's forces and by purchasers as well as by ourselves. Because of the care exercised in manufacturing, all tests have been pleasingly uniform and satisfactory.

Printed folders have been gotten out from time to time and have been of material assistance. We have distributed blueprints of typical construction, not simply the usual drawings of how to turn a corner and the like, but details and explanations of more important features like jambs, lintels and proper methods of assuring a waterproof construction at openings and parapet walls. The latter are the most common sources of entry of moisture and should be given very close attention.

Bradford Memorial Hospital, Dallas, Texas, is the type of building for which concrete masonry units are now being specified in that city

Comparing Concrete Tile and Clay Brick

The more important points on which a comparison of concrete tile and clay brick may be drawn are these:

1. Strength.
2. Permeability.
3. Weight.
4. Adhesion of covering materials.
5. Insulation.
6. Economy.

The most important structural element is strength. We are frequently asked the pointed question, "Do you claim that a concrete tile wall is as strong as a brick wall?" Our answer is that the concrete wall, while not as strong in direct compression, is several times stronger than is necessary.

For example, let us assume a two-story warehouse having a total wall height of 25 feet, the second floor and roof bearing directly on a 12-inch wall, the clear spans being 20 feet. Assume a total dead and live load of 75 pounds per square foot on the roof and 250 pounds on the floor. Under these unusually severe loadings, the unit compression at the base of the wall is only 33 pounds per square inch. Similar examples for any condition

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Condensed from paper read before joint annual meeting of the Concrete Masonry Association and the Wisconsin Concrete Products Association, Milwaukee, Wis., Feb. 23-24, 1931.

likely to be met can readily be worked out, all showing stresses well within the Bureau of Standard's safe working loads. It should be borne in mind, too, that a liberal safety factor has been used in arriving at these safe loadings. Using stronger material is like staking out the old cow with a steel cable because it is stronger than rope. Purchasing at higher cost an entirely unnecessary strength, is not economical nor sound practice.

Absorption is important, but not so much so as the actual transmission of moisture, which is more properly known as permeability. Our concrete tile have been shown to be impervious, and by using proper mortar applied in a good workmanlike manner, the wall may be expected to be waterproof providing, of course, that no water is admitted at casings, copings and other vulnerable points.

The lighter weight of concrete masonry naturally imposes less load upon the foundation and therefore reduces settlement, particularly on yielding soils such as are usually encountered at the shallow depths generally reached by such foundations.

With reference to the better adhesion of covering materials such as stucco and plaster, the surface which concrete masonry presents is ideal, being slightly rough and porous. The perfect bond is obtained.

Insulation is many times a feature worthy of promotion, the hollow air-cell construction having an advantage over solid masonry. In such structures as require special insulation, provisions may be made for ventilating the wall itself if desired.

While economy is placed last in the order of importance, this is done because we feel that quality should be firmly established before price is considered. Cost is quite frequently, however, the real controlling factor which clinches the sale. There has undoubtedly been a tendency lately on the part of builders to get the most floor area for the fewest dollars, and on present market prices we have the advantage over clay brick.

Comparative Labor Costs

Regarding the cost of labor, the friendship of masons should be so carefully cultivated that they will prepare their bids in a sympathetic frame of mind.

We have consistently endeavored to adhere to a comparative cost ratio method of analysis in so far as labor is concerned. We begin by calling attention to the fact that one of our units replaces six brick and that it can easily be laid in the time required to lay three brick. Incidentally, in so doing the mason handles substantially the same total weight of material, which seems to be an important consideration. It is obvious, therefore, that regardless of the wages of labor per hour, the labor cost on a Wall'Crete wall will be not more than one-half that of a brick wall.

Getting a Greater Share of the Business

May we summarize by saying that our promotion of concrete masonry has been rewarded with a constantly growing percentage of sales on such jobs. Whereas four years ago concrete masonry was little known in Dallas, today we have secured specifications by 26 of the 40 architects in the city on load-bearing walls. It is true that the total volume of building suffered tremendously in 1930 and our sales showed a small decrease, but upon a careful analysis of the jobs built, it can be positively stated that we secured a higher percentage of what business was available than previously. This is proof of the growing demand for concrete masonry as compared with competitive materials. Throughout the entire country we find the industry, while suffering from the depression, gaining rapidly in this percentage of available volume, which is, after all, the proper measure of success.

Ghost River Concrete Dam Completed on Schedule

Well Organized Concrete Plant Averages 600 Cu. Yd. Daily—Careful Control of Proportions—Continue Work All Winter

The recent completion of the Ghost River Dam in Alberta, 35 miles west of Calgary, Canada, has added about 37,500 horsepower to the hydro-electric power developments of the Calgary Power Company.

The Ghost River Dam is located in the Bow River, just below the confluence of the Ghost and Bow Rivers. The structure is partly of concrete and partly of earth fill.

Dam Nearly a Mile Long

Beginning at the south end, the structure consists of a length of 1,140 ft. of concrete spillway and sluiceway section; 928 lin. ft. of hydraulic fill section; 928 lin. ft. of concrete gravity section; and 885 lin. ft. of earth fill, partly hydraulic and partly rolled. The total length is 4,975 ft. The maximum height of the concrete section is 108 ft. and the highest earth section is 75 ft.

Ghost River dam under construction 35 miles west of Calgary, Alberta, Canada

Two Grades of Concrete

Two classes of concrete were used in the construction. The concrete was designed for a 28-day minimum strength of 2,500 lbs. per sq. in. in the spillway and sluiceway section, and 1,500 lbs. in the gravity section. The design strengths were more than attained.

Great care was taken with the measurement of materials for the concrete, and the water-cement ratio was held at a uniform figure. Daily checks on strength were obtained from 7-day and 28-day tests of 6 by 12 in. cylinders, all of which were made and broken by an experienced inspector of concrete work.

Place Concrete All Winter

Concreting was continued daily throughout the entire winter. The liberal use of tarpaulins and live steam prevented freezing of the freshly placed material. The work on the earth fill could be carried on only during the months when there was no frost in the ground.

The Mixing Plant

The main mixing plant consisted of two one-yard mixers, electrically driven, with the necessary elevators and conveyors. The mixing plant was located about 300 ft. from the south end of the main concrete dam. The concrete was hauled by gasoline dinkies in bottom drop buckets, and placed by derricks. The average daily quantity of concrete placed was 600 cu. yds., and the maximum daily run was 1,000 cu. yds.

Sand and gravel for the concrete work were obtained from the power company's property at a point about one-half mile from the mixing plant. The material was loaded on trucks by gasoline-driven crawler shovels. The fine and coarse materials were separated with vibrating screens. Washing was unnecessary, because of the cleanliness of the sand and gravel in their natural location.

The placing of concrete was well organized and the operation of the plan continued smoothly, practically without interruption. All concrete work was completed according to schedule.

The general contractor on this project was the Foundation Company of Canada, Limited, of Calgary. The data here given were obtained through the courtesy of J. Nelson Hood, manager.

Details of Movable Forms and Their Operation

Form Work Key Plan—Making and Raising Forms—Operation of Jack Screws—Illustrations Show Details

By RICHARD T. McKAY[1]
Masonite Corporation, Chicago, Illinois

This is the second of three articles prepared by Mr. McKay on movable forms.

Since announcement that there would be but two articles on this subject was made in the April issue, valuable material on removing forms has become available and this will appear as a third chapter, in the June issue.—The Editors.

(Continued from the April issue)

FIGURE 6 shows a detail of segments A and B as indicated on Figure 1. The number and size are listed. Figure 7 is a key plan. All the information required by the construction superintendent is given on it. When provided with Figures 1 to 7, inclusive, he can begin constructing the forms without further help from the office, all remaining details being left to him. Usually the forms are made while the foundation slab is being placed.

Making Up the Forms

A carpenter's platform is made up and placed on the ground. On this platform two circles are marked off to the diameter of the inside and outside of the tank walls. The segments A and B are laid around their respective circles, three layers of segments in each circle, and are spiked together.

The rings of segments being completed, they are moved off the platform and supported on horses while the staves are nailed to them. The 2 by 4-in. bridging, set at 45 deg. with the horizontal, is then placed against the staves and between the top and bottom rings of segments, as shown in Figure 8. When the operation has been com-

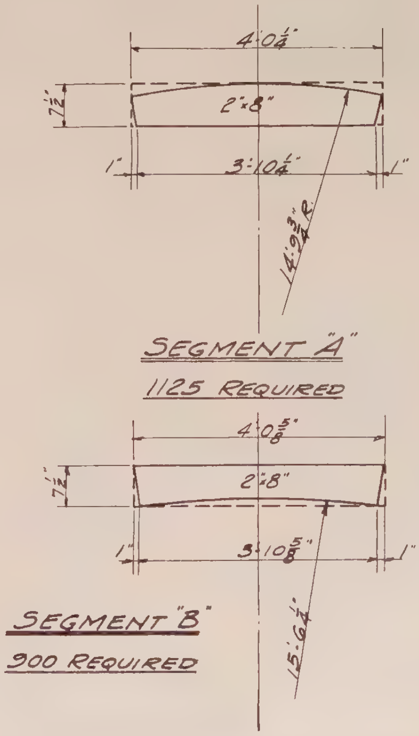

FIGURE 6

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[1] Formerly with James Stewart Corporation, Chicago, Ill.

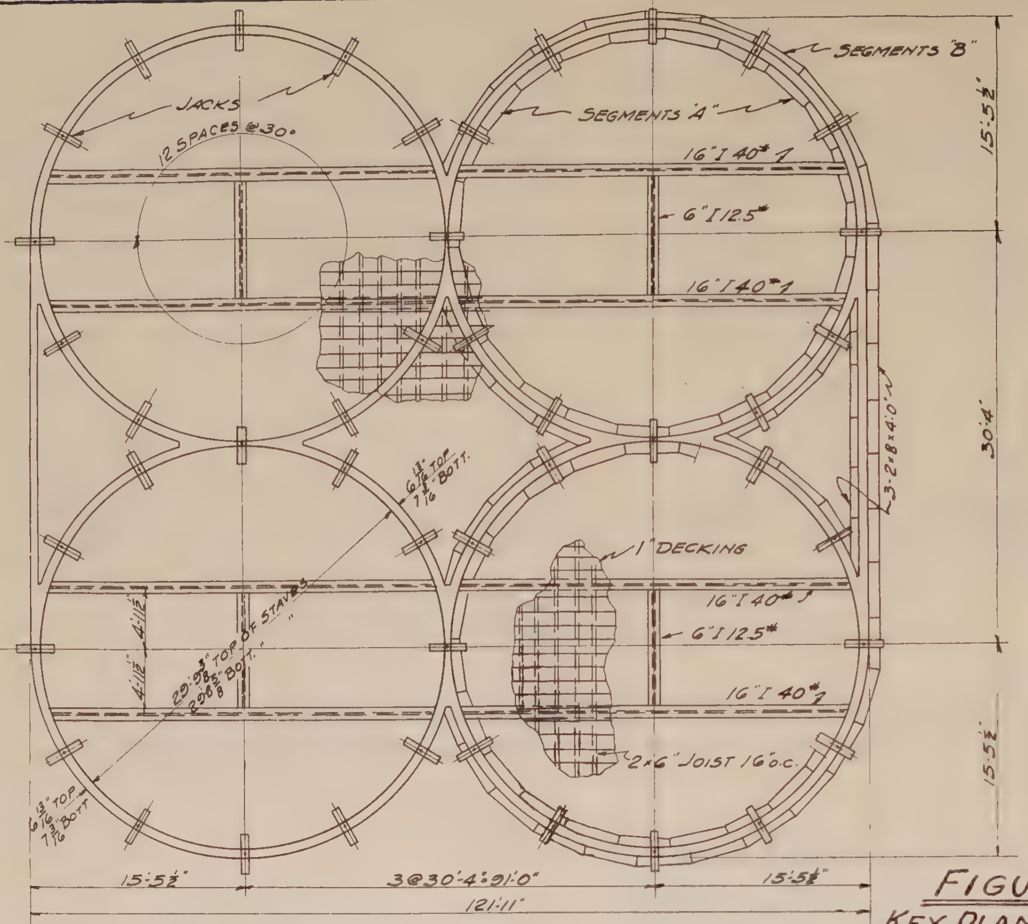


FIGURE 7
KEY PLAN OF FORM WORK

pleted, the forms are moved onto the foundation slab and the yokes, containing the jacks, and the decking are put into place. At this time the forms are given a coating of oil to prevent them from absorbing water from the concrete, as well as to reduce the bond between the forms and the concrete.

Raising the Forms

The next step incidental to raising the forms consists of the insertion of the jack screw of the jacking rod. The jack screw proper, with the clutch attached, has a bore through it large enough to allow the 1-in. plain round jacking rod to be dropped through it.

The ends of the jacking rods are milled so that they bear evenly on the foundation slab after being dropped through the jack screw. The milling also provides a level surface for splicing. The rods are spliced with the aid of a piece of 1-in. round pipe sleeve 8 in. long.

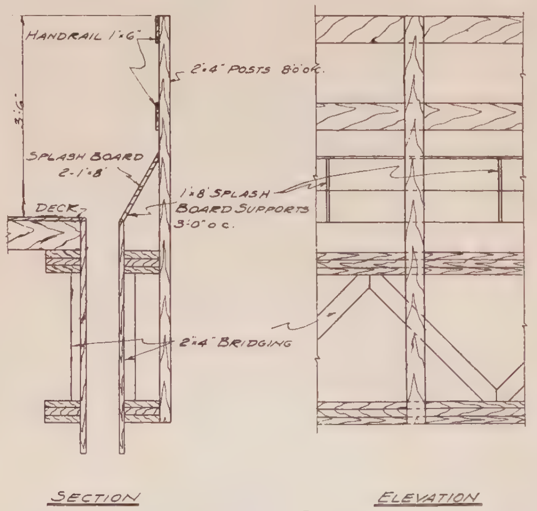


FIGURE 8
DETAIL OF SPLASH BOARD - HANDRAIL & BRACING

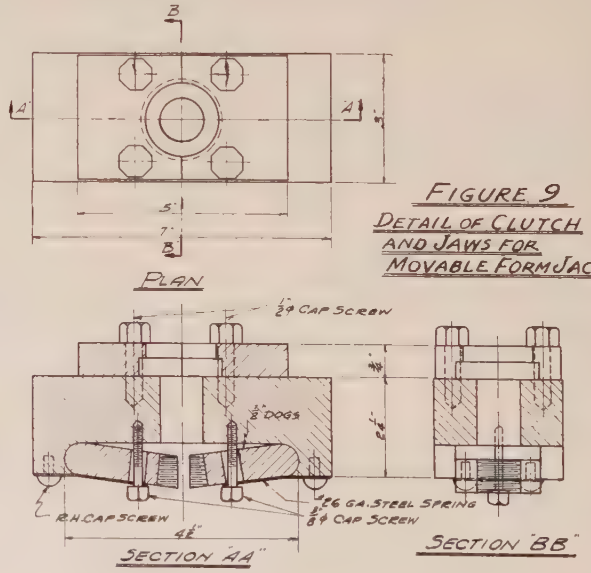


FIGURE 9
DETAIL OF CLUTCH AND JAWS FOR MOVABLE FORM JACKS

Figure 9 shows the clutch part of the jack in detail. Particular attention is invited to the ½-in. steel dogs on the bottom of the clutch. When the jacking rod is put through the clutch, these dogs tend to bear against it when the screw action is started. The two screws through the dogs are tightened up to increase the holding power of the clutch against the jacking rod. It is their action that allows the forms to be pulled up.

Before the initial jacking up of the job is started, concrete is placed in the forms. This concrete, after hardening, provides lateral stiffness for the jacking rods.

Jacking Up the Forms

Figure 10 shows a jack yoke attached to the segment rings. Formerly wooden yokes were used, but steel yokes are now used almost exclusively and can be reused indefinitely. Figure 10 shows the jack screw in the position it is to be in when moving up of the forms begins. When

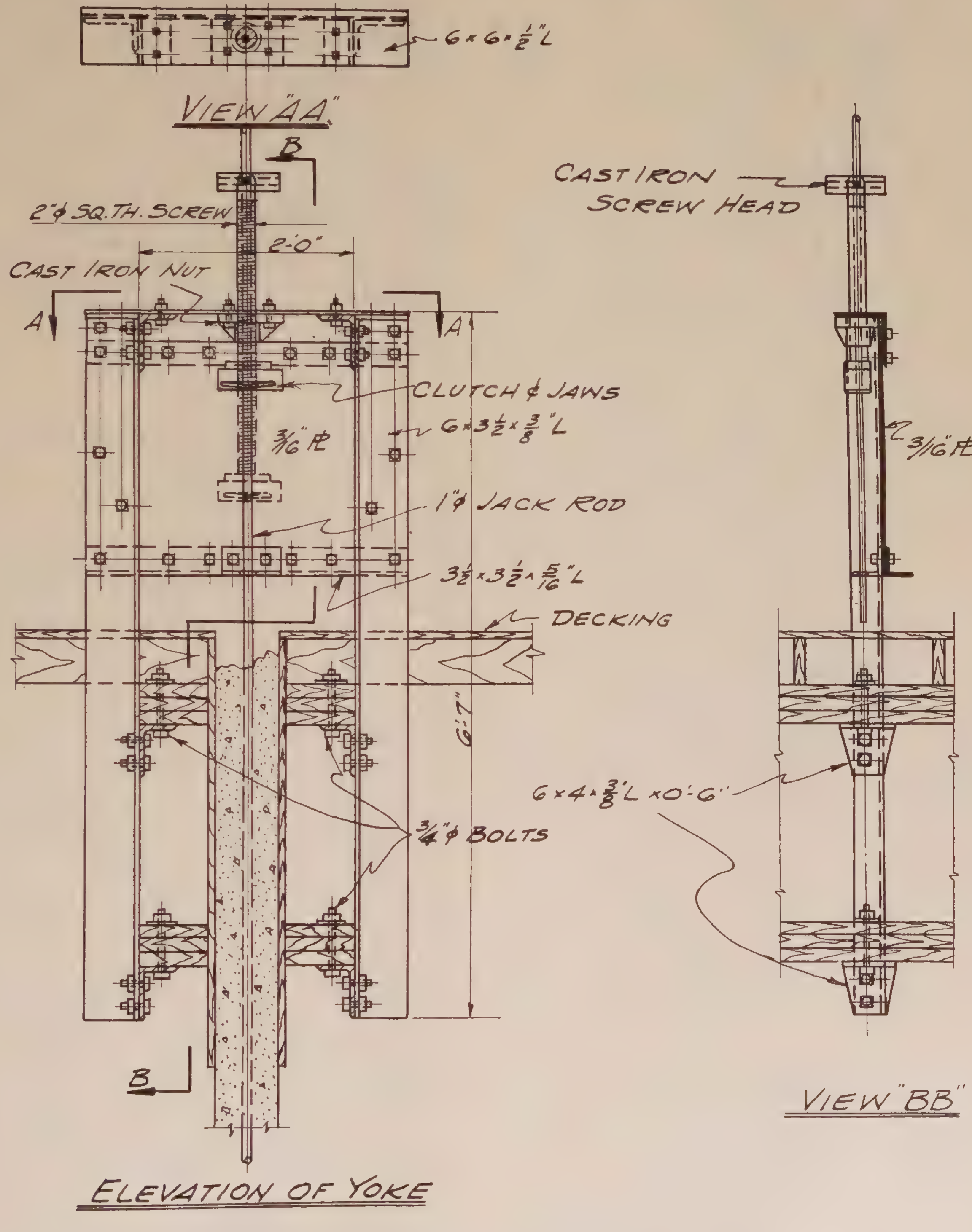


FIGURE 10—DETAIL OF JACK-YOKE

the forms have been pulled up a distance equal to the length of the screw, the jack will be in the position indicated by the dotted lines. At this juncture it is necessary to release the clutch and jaws and run the screw back up to the first position. This task requires only a few minutes' time. It is to be remembered that the jack yokes are spaced about 8 ft. on center around the tank perimeter, and that while a temporary overstress is caused by this operation it is not serious.

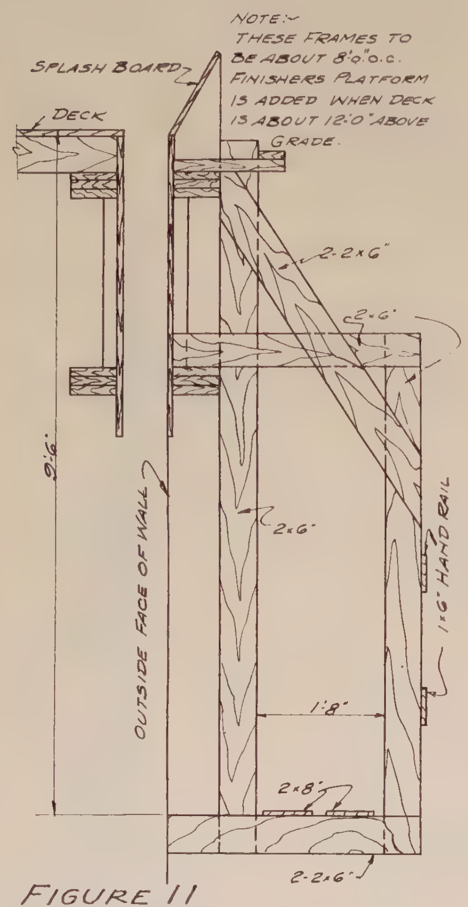

NOTE:–
THESE FRAMES TO BE ABOUT 8'0" O.C.
FINISHERS PLATFORM IS ADDED WHEN DECK IS ABOUT 12'0" ABOVE GRADE.
SPLASH BOARD
DECK
2-2×6"
2×6"
9'6"
OUTSIDE FACE OF WALL
2×6"
1×6" HAND RAIL
1'8"
2×8"
2-2×6"

FIGURE 11

FINISHERS PLATFORM

Moving Jack Screws

The work of moving the jack screws is performed at one jack at a time, of course, which means that no two jacks should be set to the same height when the jacking is started. When the concreting is started it is continued, barring accidents, 24 hours a day until the top is reached. The actual jacking is done by a laborer, who walks from one jack to another, inserts a rod in the cast iron screw head and gives it a one-quarter or one-half turn, depending on the mix of concrete being used and how fast it sets up. On a large job several laborers are used at this task, each one being allotted certain jacks to turn. It is not unusual for the forms to be lifted 10 ft. in 24 hours.

Just before concreting starts a splash board is built around the forms to facilitate the placing of concrete in the forms. A hand rail and, as the forms go up, a finisher's platform are added. These details are shown in Figures 8 and 11.

Additional Subscribers to Research Program of C.M.A.

Seventy-one new names have been added to the list of contributors to the research fund of the Concrete Masonry Association. With the 127 names of companies and individuals printed on page 42 of the April issue of CONCRETE, this brings the total number of contributors to 198, prior to April 10.

Following is the new list of 71 contributors:

Atlanta Cinder Block & Tile Company, Atlanta, Ga.
Bailey Stone Tile Company, Atlanta, Ga.
Arlington Concrete Products Company, Arlington Heights, Ill.
Chicago Granitine Manufacturing Company, Chicago, Ill.
Western Brick Company, Danville, Ill.
Edgar D. Otto, Downers Grove, Ill.
Robert J. Clark, Hinckley, Ill.
A. W. Hays, Joliet, Ill.
Shidler Construction Material Company, Kankakee, Ill.
E. L. Ramm Company, La Grange, Ill.
The Michigan Silo Company, Peoria, Ill.
Raymond Tile & Cement Company, Raymond, Ill.
Atlantic Building Supply Company, Atlantic, Ia.
Cinder Block & Material Company, Cedar Rapids, Ia.
Concrete Products Company, Cedar Rapids, Ia.
Northwest Davenport Cement Block Company, Inc., Davenport, Ia.
Iowa Concrete Products Association, Des Moines, Ia.
Harlan Cement Stone & Tile Works, Harlan, Ia.
Lake View Concrete Tile & Block Company, Lake View, Ia.
Newell Block & Tile Works, Newell, Ia.
Carlon Construction Company, Oskaloosa, Ia.
Sibley Cement Company, Sibley, Ia.
Walnut Cement Stone & Tile Works, Walnut, Ia.
Detroit Cinder Block & Tile Company, Detroit, Mich.
Preston Feather, Petoskey, Mich.
Kaufman Duntile Company, Saginaw, Mich.
Anchor Stone Company, Minneapolis, Minn.
Oscar Berg, Minneapolis, Minn.
L. E. Bogert, Minneapolis, Minn.
Carlson & Johnson, Minneapolis, Minn.
Crown Sidewalk & Block Company, Minneapolis, Minn.
Chas. Fagerstrom, Minneapolis, Minn.
Geo. W. Labo, Minneapolis, Minn.
Lynnhurst Cement Block Company, Minneapolis, Minn.
G. W. Papke, Minneapolis, Minn.
John A. Peterson & Son, Minneapolis, Minn.
Oscar Roberts, Minneapolis, Minn.
W. B. Marshner, St. Paul, Minn.
Saint Paul Cement Works, St. Paul, Minn.
Harvey A. Dwight, Albany, N. Y.
Finch & Ostrander, Inc., Albany, N. Y.
Art Stone Company, Gloversville, N. Y.
Schaefer Brothers Builders Supply Co., Inc., Rochester, N. Y.
Southampton Concrete Products Co., Inc., Southampton, N. Y.
Wm. King & Sons, Watervliet, N. Y.
Cement Products Company, Wilmington, N. C.
Cinder Products, Incorporated, Cincinnati, O.
Wm. F. Koenig, Cincinnati, O.
G. F. Potter & Son, Cincinnati, O.
Columbus Concrete Products Association, Columbus, O.
The Crume Brick Company, Dayton, O.
Nichols Concrete Block Company, Dayton, O.
McElfresh & Son, Delaware, O.
The Builders & Industrial Supply Company, Toledo, O.
Cement Products & Supply Company, Toledo, O.
Erie Cement Products & Supply Company, Toledo, O.
Kurtz Brothers, Ephrata, Pa.
Lewisburg Construction Company, Lewisburg, Pa.
Delvan Block Company, Williamsport, Pa.
Nashville Breeko Block & Tile Company, Nashville, Tenn.
Texas Concrete Products Association, Fort Worth, Tex.
Detering Concrete Tile Company, Houston, Tex.
Cinder Block Corporation, Richmond, Tex.
Blue Jay Concrete Products Company, Madison, Wis.
Cincrete Corporation, Milwaukee, Wis.
Wm. H. Devos Company, Inc., Milwaukee, Wis.
Otto Ladwig & Sons Company, Milwaukee, Wis.
Badger Concrete Company, Oshkosh, Wis.
Wood & Ringstad, Whitehall, Wis.
Leaside Block & Tile, Ltd., Leaside, Ontario, Canada.
The Cooksville Company, Ltd., Toronto, Ontario, Canada.

Manufacturers' Committee Appointed to Standardize Admixtures

A. C. I. Building Specifications Amended to Permit Use of Admixtures and Special Cements—New Committee to Co-operate With Technical Bodies

THE long-standing question of the classification and standardization of admixtures for concrete may be on the way toward solution as the result of conferences held during the recent annual meeting of the American Concrete Institute in Milwaukee.

The immediate question that led to the conference was Section 10 of the report of A. C. I. Committee 502, entitled "Tentative Construction Specifications for Concrete Work on Ordinary Buildings." This report is intended as a complete specification covering the structural concrete work in a building, and is so written that it may be utilized bodily as part of a general specification. The report was adopted as a tentative specification at the 1930 annual meeting of the Institute, in New Orleans. In that form it appears in the 1930 Proceedings of the A. C. I., pages 1 to 23, inclusive.

Report Would Hamper Use of Admixtures

In the meantime opposition had developed to Section 10 of the report, which in effect placed prohibitive restrictions on the use of admixtures or special cements by requiring them, in each case, to be "thoroughly tested by reputable independent investigators, so as to demonstrate their effect on the strength, elastic properties, permeability and permanence of concrete produced from materials such as are being used on this work."

These tests were to be required of all additions to concrete other than standard portland cement, fine and coarse aggregates, and water. Such a provision, if incorporated in a specification and interpreted literally, would in fact bar the use of all admixtures and special or high-early-strength cements, because some of the tests—the effect on permanence of concrete, for instance—could not be made within the time available.

In order to avoid a possible controversy on the floor of the convention, representatives of several manufacturers of admixtures and special cements held an informal conference during the evening just prior to the scheduled presentation of the report. Arthur R. Lord, chairman of Committee 502, was invited to attend the meeting. A. T. Goldbeck, because of his familiarity with the subject, was also invited to attend the conference in an advisory capacity, and much credit is due to Mr. Goldbeck's diplomacy for the good results obtained.

Amend Report to Permit Admixtures and Special Cements

After an extended conference the chairman of Committee 502 agreed to offer an amendment to Section 10, which in effect permits the use of admixtures or special cements if approved by the architect or engineer who is responsible for the design and supervision of the work. The approval clause was not objectionable to the manufacturers, inasmuch as all materials are subject to such approval. The following day the amendment was presented and adopted.

Committee of Manufacturers Appointed

A further outgrowth of the informal conference just mentioned comprised the appointment of a committee of manufacturers' representatives, who are to co-operate with the A. C. I. committee on admixtures.

It is expected that the manufacturers' committee will supply technical information and field data which will in due time lead to the proper classification and use of admixtures and special cements.

The membership of the manufacturers' committee includes R. E. Withrow, of the Medusa Portland Cement Company, representing waterproofing admixtures and waterproof cements; Geoff. A. Saeger, chemical engineer, Missouri Portland Cement Company, representing high-early-strength cements; and George Conahey, of the Johns-Manville Corporation, representing diatomaceous earth and other inert admixtures.

Long a Controversial Subject

The question of admixtures has long been a matter of controversial discussion, and much space has been given to the subject in the pages of CONCRETE. In the issue of December, 1929, the leading editorial set forth the need for the standardization of admixtures and urged the manufacturers of dependable products to work toward that end. "Contractors and engineers," the editorial points out, "have found through personal job experience that many admixtures do fulfill the claims made for them. They consider the advantages they bring as being worth more than the additional cost of the concrete. Yet the only method of judging their value is to try them out on the job. . . . An official classification and stamp of approval by some disinterested technical body would relieve the contractor or architect or engineer of the necessity of making his own tests or tryouts and would enable him to specify with assurance."

Similar views were expressed by Cloyd M. Chapman, consulting engineer and chairman of A. S. T. M. Committee C-9 on Concrete and Concrete Aggregates, in an article entitled "Can Admixtures Be Standardized?" printed in the June, 1930, issue of CONCRETE. "Some of the most remarkable results which are attainable by the addition of materials not commonly used in concrete," writes Mr. Chapman, "have not been broadcast in advertisements. It is noticeable, as one goes about the country meeting men interested in concrete, how many of them tell of some experience involving the use of some fourth ingredient in concrete—something besides cement, water and aggregate—and the remarkable results they obtained. These things should be verified, and in the end this perplexing matter of admixtures would no longer be mysterious."

Meeting the User's Requirements With Pre-Mixed Concrete

Plant Needs Modern Equipment and Personnel That Understands Its Use—Adequate Inspection Service

By HENRY D. JOHNSON, JR.
Designing Engineer, Bureau of Bridges, Pittsburgh, Pa.

WHEN the engineer or architect is confronted with the proposition of using pre-mixed concrete a number of questions come to his mind. Among these questions the following are paramount:

1. Does the plant maintain facilities for the inspection and testing of cement and aggregates?
2. Can the company furnish concrete according to water-cement ratio specifications?
3. Can the company furnish concrete in sufficient quantities for large runs?
4. What effect will hauling have on the strength and workability of concrete?

The plant desiring to sell centrally-mixed or truck-mixed concrete to the discriminating and conscientious engineers and architects of today must not only be able to answer these questions, but must be able to prove that the answers are correct.

The plant of today must have modern equipment and a trained personnel who thoroughly understand the basic theories of making good concrete.

Inspection Service

Many manufacturers of pre-mixed concrete provide an inspection service, either from outside sources or within their own organization to test all cement and aggregates and concrete when desired. An adequate inspection service should cover the sampling and testing of cement, the testing of aggregates, including a test of the grading, the determination of the correct proportions for the various mixes specified, adjustment of mixing water for the moisture content of the aggregates to maintain a definite water-cement ratio; and frequent representative samples should be taken of the concrete and tested at seven and twenty-eight days for check purposes.

Municipal Specification

The City of Pittsburgh, after a great many experiments with various types of equipment for measuring cement and aggregates, now specifies that all cement and aggregates must be weighed. A great advantage of weighing batches is that they can be quickly checked for accuracy.

The question of meeting water-cement ratio specifications is comparatively simple with modern equipment if the manufacturer has some one in his organization who understands the method and knows how to put it into practice on a large scale.

Effect of Hauling

As far as the effect of hauling concrete on its workability and strength are concerned, in the Bureau of Bridges of the City of Pittsburgh we have found that the strength of our mixes increases slightly during haul, whether hauled in agitator or in plain trucks. The workability of the concrete usually decreases when hauled in open trucks, due to the evaporation of the moisture in the concrete; but when agitated during transit, our tests indicate that up to forty-five minutes' hauling (which is as far as our tests have gone to date), the workability increases somewhat with mixes that have a three to four-inch slump at the beginning of the haul. The increase is not so noticeable in mixes of greater or less initial slumps.

As an example of the questions that may be asked you, how many operators of truck mixer companies could answer this question, which was recently put up to a Pittsburgh operator: "Is the concrete from your truck mixers uniform in consistency, workability, and strength, whether sampled from the front, middle, or back of the truck?"

A test was proposed, using this company's standard 1:2:4 mix with three-inch gravel, and the whole operation carried out in accordance with their usual procedure. The slumps varied from one inch to nine inches, and the strengths at 28 days varied greatly. I do not know who was the more surprised, the manufacturer of the concrete or the engineer. Proper supervision can correct such variations, and that was the case in this instance.

A second test, in which the engineer specified the mix, grading of aggregates, amount of water, and mixing time, gave slumps from three inches to five inches, and 28-day strengths from 2,955 to 3,450 pounds, limits which should be acceptable to anyone.

Condensed from paper read before the annual convention of the National Ready-Mixed Concrete Association, at St. Louis, Mo., January 26, 1931.

Aberthaw Index of Cost of Building

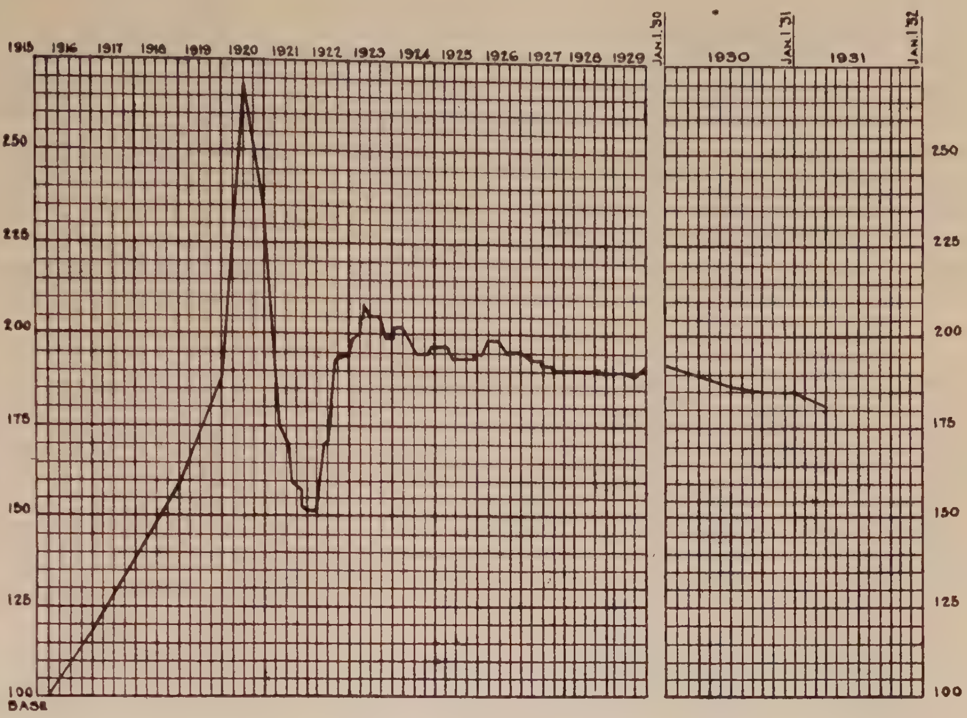
(Published in the issues of February, May, August and November)

The Aberthaw Index of Cost of Industrial Building stood at the index value of 181 on April 1, representing a drop of four points below the value on January 1.

The new index represents a cost of $1.90 per sq. ft. of floor area for the 7-story reinforced concrete industrial building used as the basis for the estimate.

Further reduction in the price of portland cement and minor reductions in prices of other materials account for this drop of four points. Construction materials on the whole continue at low price levels, but with considerable resistance against further decline.

Recent agreements with building trade unions indicate a continuation of present labor rates, with a definite trend toward a 40-hour week.



Road Builders to Hold Washington Meeting in May

The annual meeting of the American Road Builders' Association will be held in Washington, D. C., on May 15. Other meetings of old and incoming boards of directors of the national association and the various divisions will be held on May 14 and 16.

Plans will be perfected at these meetings for the work of the coming year. Among the subjects to be discussed are the appointment of joint co-operating committees with the American Association of State Highway Officials and the Highway Research Board, and the chairmen of more than a score of committees that will engage in the investigative work of the year.

Results of committee work during the past year will be reviewed and new subjects for committee work examined and approved. Members have submitted a number of new subjects for investigation.

Meetings will be held of the old and incoming boards of directors of the county and city divisions. The various executive committees will also meet and plan their work.

Calcium and Sodium Chloride

THE USE OF CALCIUM CHLORIDE OR SODIUM CHLORIDE AS A PROTECTION FOR MORTAR OR CONCRETE AGAINST FROST. By Dr. W. N. Thomas. Published as Special Report No. 14 by the Department of Scientific and Industrial Research, 16 Old Queen Street, Westminster, S. W. I., London, England. Paper cover, 6 by 9½ in., 30 pages. Price 9d. net.

A digest of this interesting pamphlet was published on Page 24 of the April issue of CONCRETE. The report deals in detail with many phases of the subject, including the different brands of cement, the effect on the freezing point, the strength and the setting time, and the corrosive action on steel.

Manufacturing Costs of Concrete Units

MAKING PRECAST CONCRETE FOR PROFIT. By A. E. Wynn. Published by Concrete Publications, Ltd., 20 Dartmouth St. S. W. 1, London. Stiff paper cover, 7 by 10 inches, 42 pages. Illustrated.

This book discusses the information required for the study of a market, and other chapters take up problems such as cost distribution, bookkeeping, monthly cost summary, and the study of costs. While the book applies more specifically to conditions in England, it offers information and methods applicable to the industry in this country.

In the Technical Society Journals

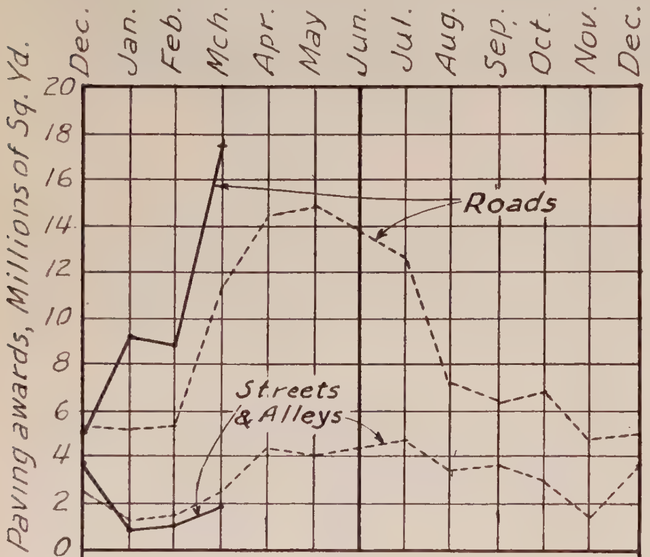
Shrinkage of Concrete in Actual Structures. The March (1931) Journal of the Boston Society of Civil Engineers, 715 Tremont Temple, Boston, Mass., contains a 15-page paper under this title, by William M. Bassett. The author describes how the large structures comprising the Fifteen-Mile Falls power development on the Connecticut River were designed so that changes in bulk might cause the least possible damage to the structure.

Bond Between Floor Finish and Slabs. An illustrated paper entitled "Tests of Bonding of Floor Finish to Slabs of Haydite and Gravel Concrete," in the December (1930) *Journal* of the American Concrete Institute, 2970 W. Grand Blvd., Detroit, describes tests of the bonding value between a ¾-in. finish course and a 5-in. reinforced concrete structural slab. The finish course consisted of a 1:1:2 mixture of cement, sand and pea gravel, with 5 gallons of water to the sack of cement. For the slabs, two mixtures were used, one a fairly rich structural concrete with proportions of 1:2¼:2¾, and the other a 1:4½:5½ mixture considered suitable for floor fill. The slabs of both the rich and the lean mixtures were made of the two kinds of concrete tested, namely, sand and gravel from regular commercial sources, and fine and coarse haydite.

Paving in First Quarter 43 Per Cent Above Last Year

March Is Record Month in Concrete Road Awards—General Construction Picking Up

With the monthly record of 17,572,871 sq. yd. of concrete highway pavements awarded in March added to the heavy totals of the first two months of the year, and with concrete street and alley pavement contracts running in fair volume, the first quarter of the present year chalks up a grand total of 38,976,870 sq. yd. of concrete roads and pavements, according to reports received by the Portland Cement Association. This is 43 per cent above the awards in the first quarter of 1930, and is an all-time record both for the quarter and for the month.



Dotted lines indicate 1930 contracts
Solid " " 1931 "

Total concrete paving contracts, in Sq Yd., in first 3 months of year—

	1930	1931
Concrete Roads--	21,895,395	35,112,165
Strects & Alleys---	5,285,719	3,864,705
Totals--	27,181,114	38,976,870

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The comparison with last year is shown in the chart.

REQUIREMENTS FOR FIRE RESISTANCE IN BUILDINGS

The Building Code Committee of the United States Department of Commerce has issued its Recommended Minimum Requirements for Fire Resistance in Buildings. Various materials and methods of construction are recommended for stated periods of fire protection ranging from one hour to four hours.

The features of this 58-page booklet that deal essentially with monolithic concrete and concrete masonry building units will appear in the June issue of "Concrete."

General Construction in Healthy Condition

In the general construction industry the F. W. Dodge Corporation sees a healthy sign in the seasonal but well distributed advance in contracts awarded in March, as compared with February. While the comparison with a year ago is less favorable, the fact remains that six of the thirteen districts from which the Dodge reports are received show an advance over March, 1930.

Total contracts reported by the Dodge organization in 37 states east of the Rocky Mountains amount to $370,406,300, compared with $456,119,000 a year ago.

"A Single Breaker May Recede,—But the Tide Is Coming In"

Business is on the turn. The demand for competent men will soon be setting in. When your turn comes, here's the means to find the man you want.

AMERICAN TRADE ASSOCIATION EXECUTIVES
and
NATIONAL ENGINEERING SOCIETIES

have today rosters of surprisingly well-qualified business executives and technicians. The present emergency has made available men of splendid experience.

If and when you are in need of executives, communicate with:

American Trade Association Executives,
45 East 17th Street, New York City

Should your requirements be for professional engineers or technicians, write to one of the following:

Walter V. Brown,
Engineering Societies Building,
31 West 39th Street, New York City.

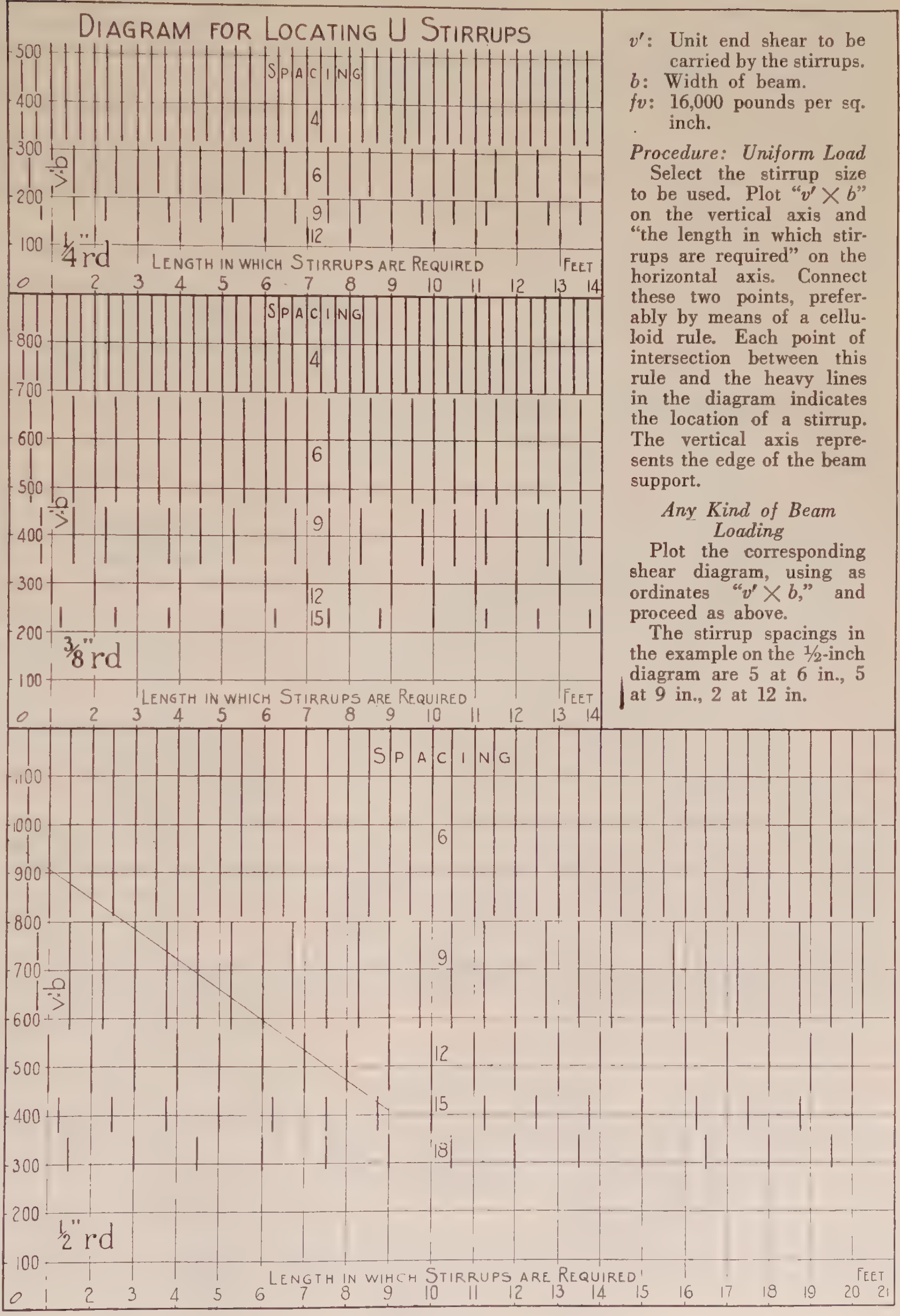
Engineering Societies' Employment Service,
1216 Engineering Building,
205 West Wacker Drive, Chicago.

This work is the free contribution of these professional organizations to industry.

U-Stirrups in Concrete Beams Located With Chart

Method Applicable to Both Uniform and Concentrated or Irregular Loading—Construction of Chart Described—Use Illustrated With Example

By T. GERMUNDSSON
Assistant Engineer, Kalman Steel Co., Chicago, Ill.



v': Unit end shear to be carried by the stirrups.
b: Width of beam.
f_v: 16,000 pounds per sq. inch.

Procedure: Uniform Load

Select the stirrup size to be used. Plot "$v' \times b$" on the vertical axis and "the length in which stirrups are required" on the horizontal axis. Connect these two points, preferably by means of a celluloid rule. Each point of intersection between this rule and the heavy lines in the diagram indicates the location of a stirrup. The vertical axis represents the edge of the beam support.

Any Kind of Beam Loading

Plot the corresponding shear diagram, using as ordinates "$v' \times b$," and proceed as above.

The stirrup spacings in the example on the ½-inch diagram are 5 at 6 in., 5 at 9 in., 2 at 12 in.

LOCATING stirrups in reinforced concrete beams is a rather lengthy and cumbersome process. The method described here will reduce the labor involved to a considerable extent.

The large chart here shown is a diagram constructed for ¼, ⅜, and ½-in. round U-stirrups. It consists of a series of vertical lines spaced 4, 6, 9, 12, 15, and 18 in. apart. The vertical axis represents the edge of the support. The heavy vertical lines represent stirrup groups. The tensile unit stress in the stirrups is taken at 16,000 lb. per sq. in.

Notation:

v' = Unit end shear to be carried by the stirrups.
L = Length of beam in which stirrups are required.
b = Width of beam.

In order to locate U-stirrups proceed as follows: Find on the vertical axis the value of $v'b$ and on the horizontal axis the value of L. The line connecting these points intersects the stirrup groups and indicates by the number of lines it crosses the number and spacing of stirrups required.

The advantage in using this method of locating stirrups becomes particularly pronounced in the case where the loading consists of combined uniform and concentrated loading, as in the following example:

Example: Clear span = 18 ft.; concentrated load in

$V = \frac{}{0.88} \times 18 \times 12 = 12$

center of beam = 28,000 lb.; $w = 1{,}000$ lb. per lin. ft.; $b = 12$ in.; $d = 18$ in.; unit shear taken by the concrete = 40 lb. per sq. in.

Total end shear: $V = 9 \times 1{,}000$ plus $0.5 \times 28{,}000 =$ 23,000.)

Unit shear at concentrated load =

$$\left(v = \frac{14{,}000}{0.88 \times 18 \times 12} = 74 \right) \text{wrong}$$

$v' = 121 - 40 = 81$

$v' \times b = 81 \times 12 = 970$

Unit shear at concentrated load =

$$v = \frac{14{,}000}{0.88 \times 18 \times 12} = 74.$$

$v'_1 = 74 - 40 = 34$

$v'_1 \times b = 34 \times 12 = 408$; or 410 in round numbers

$L = 0.5 \times 18 = 9$ ft.

The line connecting 970 on the vertical axis and 410 on the line $L = 9$ ft. gives the number and spacing of stirrups as follows: 5 at 6 in., 5 at 9 in., 2 at 12 in. The correct spacing, in inches, is 7, 7, 7, 7, 8, 8, 8, 9, 9, 10, 11, 11.

It will be noted that the large chart can be used for varying beam widths and regardless of the amount of shear the concrete is allowed to carry.

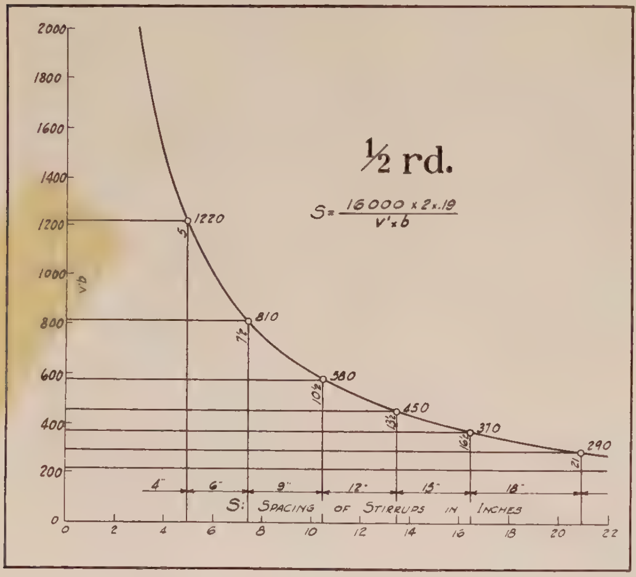


Diagram used in constructing chart

Simple computations make it possible to use the diagrams for any stirrup size, for any value of the unit tensile stress, and for stirrups with any number of legs.

The method applied in constructing the large chart is illustrated in the small diagram, in which the curve represents the formula:

$$\text{Spacing of stirrups} = \frac{16{,}000 \times A_v}{v'b}$$

Theoretically, the spacing of stirrups would vary for each unit length of a uniformly loaded beam. From a practical standpoint, however, it is not desirable to change the spacing too frequently. Spacings of 4, 6, 9, 12, 15 and 18 in. were therefore chosen.

The small diagram shows how each of these spacings covers a certain range of values of $v'b$. A spacing of 9 inches is, for instance, used instead of all spacings from 7½ to 10½ inches corresponding to values of $v'b$ varying from 810 to 580.

The heavy vertical lines on the large chart extend within the ranges thus determined on the small diagram.

Building Inspection Officials Hold Seventeenth Annual Meeting

The Building Officials' Conference of America held its seventh annual meeting at the King Edward Hotel, in Toronto, Canada, from April 21 to 24, inclusive. Subjects dealing with the construction and inspection of buildings and the use of building materials were discussed in papers read at the conference.

Fire limits, building restrictions, uniformity in city building regulations, and safety measures in construction work, were some of the subjects covered.

The last-named subject, under the heading of "Standard Safety Code for Construction Work," was discussed at length in a paper by Rudolph P. Miller, consulting engineer, New York City. The proposed safety code, prepared by a committee representing the American Safety Council, provides for the proper protection of workmen and pedestrians during construction.

Cincinnati Products Association Officers Are Re-elected

Herman Forste was re-elected president of the Cincinnati Concrete Products Association at its recent annual meeting. George F. Potter remains secretary-treasurer and William F. Koenig represents the group on the credit board.

Estimating Cost of Concrete Work

Everyone who estimates the cost of concrete work, whether preparing the contractor's bid or the designer's preliminary estimate, will find authentic and detailed information of a most helpful kind in a series of articles on "Estimating the Cost of Concrete Work," starting in the June issue of CONCRETE.

The scope to be covered by these articles is indicated by the following outline of the subject-matter:

(1) Quantities of concrete work.
(2) Concrete labor and material costs.
(3) Form work quantities and materials.
(4) Form work labor costs, including making up, erection and removal.
(5) Placing steel reinforcement.
(6) Cost of finishing.
(7) Cold weather expenses.
(8) Insurance.

The author, Leslie H. Allen, is a construction engineer who has had wide experience with organizations such as the Aberthaw Company and the Fred T. Ley Construction Company. He is exceptionally well qualified to deal with the subject of estimating. In these articles he sets forth his methods and explanations clearly, in a manner that is easily followed.

HOW TO DO IT

✦ Questions and Answers ✦
Consultation and Comment

A department devoted to the solution of problems encountered in concrete work. Readers are welcome to add to or improve upon the suggestions printed and to submit their views for possible publication.

Pressure on Concrete Forms and Spacing of Form Ties

Has anything in the nature of standard practice been developed with respect to the spacing of tie rods in forms for concrete walls? I will also appreciate data on the pressure exerted against wall forms by fresh concrete.—B.P.H., Chicago, Ill.

Both the spacing of tie rods and the pressure against forms are influenced by the rate at which the forms are filled. If the concrete is placed so rapidly that the forms are filled at a rate of 6 ft. of depth per hour, the pressure is naturally greater and ties must be spaced closer than if the rate of placing is only 3 ft. of depth per hour. The pressure is also influenced by the temperature of the concrete. Obviously, if the temperature of the concrete is 70 deg. F. it will set more quickly than if the temperature is 50 deg. In the latter case the concrete remains in a semi-fluid state much longer, and the pressure on the forms at a given point is much greater than if the 70-deg. temperature is maintained.

As to the maximum pressure on concrete forms, information on this point is found in a table printed on page 46 of the November (1930) issue of CONCRETE. For the convenience of readers the table is repeated here as Table I. Unfortunately, the table as originally printed referred to the pressures as being expressed in lb. per sq. in., whereas the values given were in fact expressed in lb. per sq. ft.

Table I—Pressure on Concrete Forms, Expressed in Lb. per Sq. Ft.

Vertical fill of concrete per hour	Temperature of concrete mass				
	80 deg.	70 deg.	60 deg.	50 deg.	40 deg.
2 ft.	530	560	600	680	790
3 ft.	690	720	810	920	1080
4 ft.	820	870	980	1130	1340
5 ft.	930	990	1120	1310	1570
6 ft.	1020	1090	1250	1480	1780
7 ft.	1090	1170	1350	1620	1970
8 ft.	1130	1240	1440	1740	-------

More direct information is contained in a small table in a drawing designated as Figure 37, on page 39 of the July (1930) issue of CONCRETE. This table, shown here as Table II, gives the vertical spacing of ties and waling strips, and the horizontal spacing of ties, required for various rates of vertical fill of concrete per hour. Table II is based on the use of 7/8-in. form boards, 3 by 4-in. vertical studs spaced 24 in., 2 by 6-in. double waling strips, and 3/4-in. or 5/8-in. tie bolts or any ties of equivalent tensile strength.

Table II—Spacing of Waling Strips and Tie Bolts

Vertical fill of concrete per hour	Vertical spacing of waling strips, in inches	Horizontal spacing of tie bolts, in inches
3 ft.	42	54
4 ft.	36	48
5 ft.	28	45
6 ft	24	42

Foundations on Silt or Peat Beds

We have the serious problem here of providing concrete foundations for dwelling houses in a large area having underlying peat beds from 6 to 25 ft. deep. What do you suggest as the best type of footing for walls and basement posts?—L. B. R., Flint, Mich.

Somewhat similar conditions exist in a southern city, where a large residential section is built over river silt beds of unknown depth, borings to depths of 50 feet and more having failed to reach anything harder.

In that case it is customary to use wall footings consisting essentially of reinforced concrete slabs 12 inches thick and 3 to 4 feet wide. These slabs can be laid practically on the surface of the ground, because the frost does not penetrate very deeply, during their short and mild winters, and dwelling houses as a rule have no basements.

In buildings having basements, however, the same principle can be followed, the broad footing or slab being, in that case, the footing for the basement wall. It must have steel reinforcement both crosswise and lengthwise, and the lengthwise reinforcement must be well overlapped and bent around corners, so that the footing reinforcement will be continuous.

The width of this footing slab must be such that the load on the soil will be not more than 1,000 lb. per sq. ft., and less, if possible. The same is true of the footings of interior basement columns.

All this requires careful figuring of the approximate weight of the building and foundation walls, and that means that a competent architect or structural engineer should be employed to prepare the foundation plans. Any attempt to eliminate the cost of having the foundations properly figured may only lead to grief later—and to far greater cost.

Structural Properties of Haydite Concrete

Where can I get reliable data on the structural properties of haydite concrete, such as a designer of reinforced concrete structures needs for his design computations?—K. Z. N., Chicago, Ill.

A complete report on tests to determine the structural properties of haydite concrete, conducted at the University of Illinois, will be found in the October (1930) *Journal* of the American Concrete Institute, beginning on page 151. An abstract containing the results and conclusions was printed in the February, 1931, issue of CONCRETE.

The Concrete Industry
—25 YEARS AGO

"AN excellent example of true reinforced concrete" . . . "not a case of armored steel but a scientific combination of concrete and steel reinforced in such a manner as to produce an extremely light and symmetrical structure."

Such is the description of a concrete bin for cinders, illustrated in an accompanying picture and located at a railroad siding at Watseka, Illinois.

The bin is 42 feet high and 16 feet square, with a capacity of 80 tons. With the exception of 4 columns and 3 tie beams, it is pointed out in the May, 1906, issue of CONCRETE, there are no girders or other visible supports.

Its side walls, it is explained, are 5 inches thick and support the 8-inch bottom, which is heavily reinforced in both directions.

~

FIRE losses in the United States have trebled since the figure for 1905 was placed at $105,000,000.

The recent annual report of the National Fire Protection Association shows that damage of $465,000,000 was caused in 1930.

~

A PLEA for uniformity in reinforced concrete design outside of "systems" is contained in a short article on this subject.

"Reinforced concrete," it is stated, "should be reduced to uniform standards. There is no reason why reinforced concrete cannot be brought to the same state of uniformity as structural steel construction. . . . "

"Standard methods should be adopted in such a form that the architect, engineer or contractor is made entirely independent of the so-called 'systems.' At the same time the standards should be so arranged that where it is shown profitable, a patented section could be substituted for the reinforcement shown upon the plans of the designer."

~

MANUFACTURE of concrete monuments and tombstones was already under way in New England in 1906. According to a brief item in the May issue of *Cement Age* of that year, "A Northboro, Mass., man is the promoter and manager of a new industry, that of making monuments and tombstones out of concrete and cement, and the cost is said to be one-tenth that of granite or marble."

~

ECONOMIES in the use of reinforced concrete were then, as now, of a great deal of interest and various methods are suggested by E. P. Goodrich, Jun. Am. Soc. C. E.

In dealing with economies in the mixing of concrete, the author suggests three or four principles, among them that in the handling of materials as much use as possible be made of gravity, and that mixing should be done as near the point of installation as possible.

~

ANNOUNCEMENT is made that the committee on waterproofing materials of the American Society for Testing Materials is to issue a circular letter to all manufacturers of such materials, asking for descriptions of their product and how it is applied, and whether they would be willing to have their materials examined and the results published.

Organizations

AMERICAN CONCRETE INSTITUTE; Harvey Whipple, Secretary, 2970 West Grand Blvd., Detroit, Mich.

AMERICAN CONCRETE PIPE ASSOCIATION; M. W. Loving, Secretary, 33 West Grand Ave., Chicago.

AMERICAN ROAD BUILDERS' ASSOCIATION; Chas. Upham, Engineer-Director, 914 National Press Building, Washington, D. C.
Annual meetings, May 15-16, National Press Building, Washington, D. C.

AMERICAN SOCIETY OF CIVIL ENGINEERS; Geo. T. Seabury, Secretary, 33 West Thirty-ninth St., New York City.

AMERICAN STANDARDS ASSOCIATION; P. G. Agnew, Secretary, 29 West 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS; C. L. Warwick, Secretary-Treasurer, 1315 Spruce St., Philadelphia, Pa.
Annual meeting, June 22-26, Stevens Hotel, Chicago.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA; E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

BUILDING OFFICIALS CONFERENCE OF AMERICA; Col. John W. Oehmann, Secretary, 1253 Lawrence St., N. E., Washington, D. C.

CANADIAN ENGINEERING STANDARDS ASSOCIATION; 178 Queen St., Ottawa, Ontario.

CAST STONE INSTITUTE; L. A. Falco, Secretary, Chapel St. and Blatchley Ave., New Haven, Conn.
Annual convention, May 11-12, Hotel Cleveland, Cleveland, Ohio.

CEMENT INSTITUTE; Luther G. McConnell, General Manager, 11 East 44th St., New York City.

CONCRETE MASONRY ASSOCIATION; Jack Franklin, Secretary, 7071 Plankinton Bldg., Milwaukee, Wis.

CONCRETE REINFORCING STEEL INSTITUTE; M. A. Beeman, Secretary, Tribune Tower, Chicago.

ENGINEERING INSTITUTE OF CANADA; 2050 Mansfield St., Montreal, Quebec.

JOINT COMMITTEE ON STANDARD SPECIFICATIONS FOR CONCRETE AND REINFORCED CONCRETE; F. R. McMillan, Secretary, 33 West Grand Ave., Chicago.

NATIONAL BOARD OF FIRE UNDERWRITERS; W. E. Mallalieu, General Manager, 85 John St., New York City.

NATIONAL CONCRETE BURIAL VAULT ASSOCIATION; J. H. Stuart, Secretary-Treasurer, Bremen, Ohio.
Annual meeting, May 20-21, State Fair Grounds, Columbus, Ohio.

NATIONAL CRUSHED STONE ASSOCIATION; J. R. Boyd, Secretary, 751 Earle Bldg., Washington, D. C.

NATIONAL ENGINEERING INSPECTION ASSOCIATION; B. H. Witherspoon, Secretary, P. O. Box 1115, Pittsburgh, Pa.

NATIONAL FIRE PROTECTION ASSOCIATION; Franklin H. Wentworth, Secretary, 40 Central St., Boston, Mass.
Annual meeting, May 12-16, Toronto, Ontario, Canada.

NATIONAL LIME ASSOCIATION; Norman G. Hough, Secretary and Manager, 927 Fifteenth St., N. W., Washington, D. C.
Thirteenth annual convention, June 3-4, White Sulphur Springs, W. Va.

NATIONAL READY-MIXED CONCRETE ASSOCIATION; Headquarters, 27 Barbeau St., Pittsburgh, Pa.

NATIONAL SAND AND GRAVEL ASSOCIATION; V. P. Ahearn, Executive Secretary, 432 Munsey Bldg., Washington, D. C.

NATIONAL SLAG ASSOCIATION; H. J. Love, Secretary-Treasurer, 937 Leader Bldg., Cleveland, Ohio.

NATIONAL TERRAZZO AND MOSAIC ASSOCIATION; U. F. Durner, Secretary, 809 St. Paul Ave., Milwaukee, Wis.

NORTHWEST CONCRETE PRODUCTS ASSOCIATION; W. P. Hews, Secretary-Treasurer, Yakima, Wash.

PORTLAND CEMENT ASSOCIATION; William M. Kinney, General Manager, 33 West Grand Ave., Chicago.

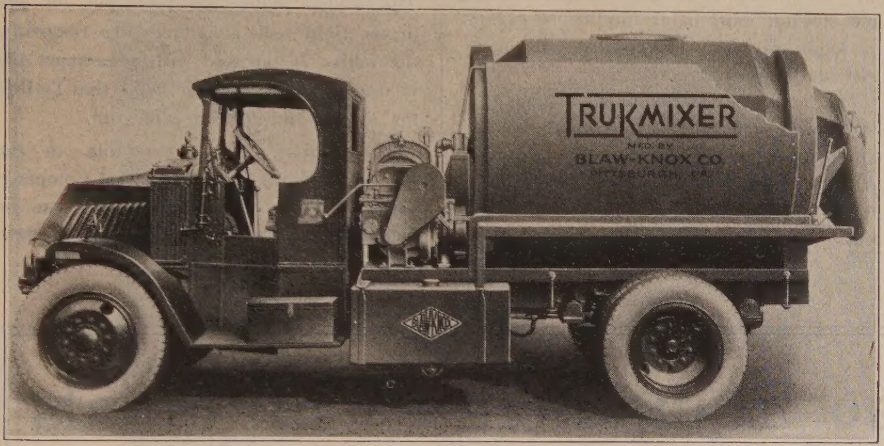
RAIL STEEL BAR ASSOCIATION; H. P. Bigler, Engineering Secretary, Builders' Bldg., 228 N. La Salle St., Chicago, Ill.

WISCONSIN CONCRETE PRODUCTS ASSOCIATION; Jack Franklin, Secretary-Treasurer, 425 East Water St., Milwaukee, Wis.

New Equipment and Materials

Blaw-Knox "Trukmixer" Mixes En Route or Conveys Premixed Concrete; Functions Automatically

After years of research and development the Blaw-Knox Company has placed on the market a truck mixing unit which is not only designed for mixing but can be used as a closed-type agitating body for conveying premixed concrete.



Its design is said to insure positive water control, thorough and uniform mixing, rapid mixing, and clean discharge of all consistencies of concrete mixes, and many other details that have proven troublesome to solve.

The mixing drum is octagonal in shape, tapered on both ends and automatically reverses rotation during mixing, for true end to end mixing action. The blades within the drum are designed for most efficient mixing within a given time. The octagonal shape of the Trukmixer drum helps the mixing action because with a series of sides and vertexes the concrete is lifted and displaced many times more than it is in a drum which is cylindrical in shape, it is stated.

The measurement of water is entirely removed from the control of the truck mixer. A forced feed automatic water supply system is used which can be set for the amount of free water to be deposited into the batch of concrete, and no more water can be placed in the batch than is actually specified.

The water supply tanks on the Blaw-Knox "Trukmixer" are carried beneath the chassis, which helps to lower the center of gravity of the entire unit, increases the life of the outfit and helps the rigidity of both truck and mixing body.

The discharge door is of the screw type which lends itself more easily to the control of the discharge. In the discharge of the concrete the operator controls the action of the drum from the discharge end, and the discharge is rapid and positive without pulsation, the Blaw-Knox Company states.

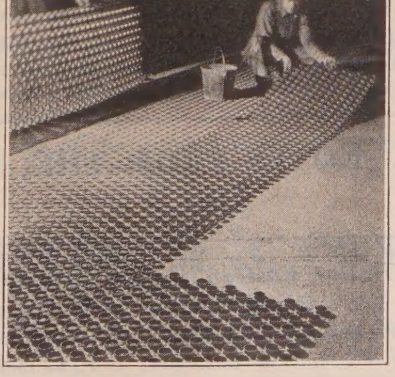
Blaw-Knox "Trukmixers" are made in capacities of 2, 3, 4 and 5 cubic yards for mixing, and from 2 to 8 cubic yards for agitating pre-mixed concrete.

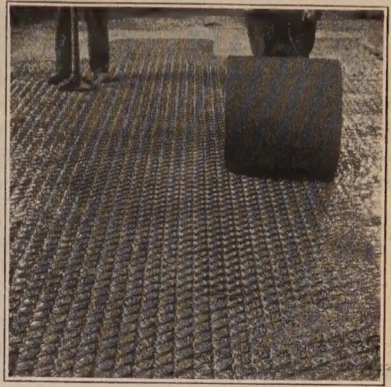
"Coat of Mail" New Type of Steel Floor Armoring

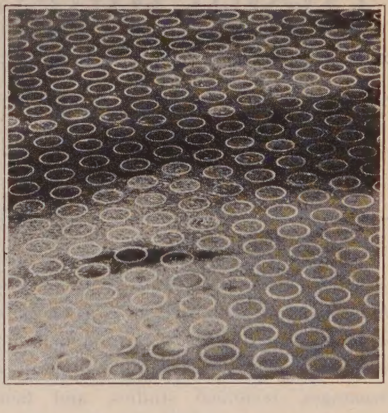
"Coat of Mail" is a new type of floor armoring having long life, good reinforcing quality and that is quickly laid, according to the A. O. Smith Corporation, Milwaukee, Wis.

Its design consists of rings instead of the more common straight lines. The continuous mat is obtained by a simple locking together of standard panels, each 20 sq. ft. in area, placed on the wet concrete.

The mix is first placed and screeded off to the finished grade height, the Coat of Mail panels placed on this surface, and the locking clips applied. After a series of panels has been placed and locked together, the entire mat is rolled or tamped. This is continued until the armoring is submerged in the concrete and the top of the rings is flush with the surface.







Smithsteel Coat of Mail can be used in both monolithic and terrazzo construction, an illustration in the latter being shown in the illustrations.

Aggregate Scale Has New Tell-Tale Device

An accurate, light-weight, sturdy scale for measurement of aggregate by weight instead of by volume has been developed by Fairbanks, Morse & Co., Chicago.

A new style springless "over-and-under" tell-tale device, protected from dust and corrosion, is connected with the beams and so mounted that it can be swung to any angle to insure easy reading from any position of the operator.

All weighing can be done on the one scale, as it is provided with a tare bar and two beams, one for sand and one for stone.

This scale provides an accurate scientific control of the mix and enables the contractor to meet rigid specifications without increasing the labor cost of mixing. There are two sizes, one of which has a 42-in. by 30-in. platform for weighing wheelbarrows and weighs complete only 275 lbs. The other has a 42-in. by 42-in. platform, especially designed for weighing materials in carts or buggies; it weighs 320 lbs.

Either the sand or the stone beam may be thrown into weighing position independently of the other, and all poises may be locked in position. In addition, the beam box may be locked after the poises are set so that they cannot be tampered with.

“Ace” Is New Blue Ribbon Unit for Economical Production

Designed for economical block manufacture, the new Blue Ribbon Ace machine has just been announced by J. D. Abram, president of Abram Blue Ribbon, Inc., to supply the demand for a high production, low cost downface stripper machine.

Another of the features of the Ace is the way in which it may be purchased. For minimum expenditure, the block manufacturer may first install the hand unit alone, then add the power tamper unit, and later the strike-off and automatic finisher, the power feeder, including material magazine and power take-off, and to complete the outfit, the mixed material elevator. This method of assembling is possible and the total cost is the same as if purchased all at one time.

All patented working principles of other Blue Ribbon models, including the Blockmaker and the Autocrat, are designed into the Ace, it is stated, the tamper, feeder and elevator units being duplicates, except for slight alteration in design to harmonize with the new construction.

The mold box is claimed to make a remarkably efficient hand-operated machine, producing units as wet as those from a power unit. Like the other units of the machine, the box embodies the original patented features, such as initial stripping, heavy one-piece core carrier, rigid core assembly, steel core wear plates, and instantly removable end doors. It may also be converted to make all sizes possible on the larger models, as well as special and random ashlar units.

Improved Economy Ty-Rod Easy to Use

Tightening and clamping with a hammer is said to be all that is necessary in using the improved Economy Ty-Rod clamps on wall forms. Forms are erected as usual, and holes bored where ties are desired. The Ty-Rods are assembled with stud bolts and the complete tying unit inserted through the entire form like a plain rod. The wedge plates are then put on and driven tight with a hammer. In removing, the wedge is loosened with a hammer and is used as a wrench to twist the Ty-Rod for unscrewing it from the stud.

The wedge plates, according to the Fischer & Hayes Rope and Steel Company, Chicago, Illinois, cannot slip and can be depended upon to develop the full strength of the tie rods.

About Makers of Equipment and Materials

INDUSTRIAL LITERATURE

Ayr Syl Admixture

An 8-page folder recently issued by the *Industrial Chemical Sales Company*, New York City, describes *Ayr Syl*, diatomaceous admixture, and its sources and properties, advantages, technical studies, and field demonstrations. Quantities and directions are also given.

Ayr Syl is said to be a carefully processed and milled silica that imparts a lubricant imparting plasticity to the entire mix with resulting workability and prevention of segregation.

Efficient Four-Cylinder Engine

A new development in 4-cylinder industrial power units is the 10-12 hp. *NNU Four engine*, described in a 4-page circular issued recently by the *Novo Engine Company*, Lansing, Mich.

This is described as a high compression unit meeting all power requirements in its range and giving the greatest horsepower per pound of engine. At the same time it is ruggedly and compactly built and automotive in design.

PTL Celebrates 50th Year

A brochure in commemoration of its fiftieth anniversary is being distributed by the *Pittsburgh Testing Laboratory*, Pittsburgh, Pa. PTL service in physical testing, chemical analysis, engineering inspections, and research is described and innumerable illustrations are used to show the work of each department.

Truscon House Organ

Truscon, “a graphic monthly devoted to construction, maintenance and steel products,” made its appearance recently as the new house organ of the *Truscon Steel Company*, Youngstown, Ohio. The April issue is an ambitious publication of 16 pages, 11¼ by 16 inches.

Its early pages are occupied by portraits of the executive personnel of the 1931 Architectural and Allied Arts Exhibition.

NOTES FROM THE FIELD

Butler Eastern Representative

The Butler Bin Company of Waukesha, Wisconsin, announce the appointment of *H. W. Butler* of Rochester, N. Y., as their eastern field representative and sales engineer.

Mr. Butler’s previous experience as general superintendent for Whitmore Rauber & Vicinus of Rochester, N. Y., gave him experience that eminently fits him for the duties he assumes, as they embrace general contracting, material handling, and central mixing plant operation. Mr. Butler will travel in the East contacting the various Butler Bin Company distributors in that territory and assist them in their sales efforts on Butler equipment.

Dunbrik Regional Director

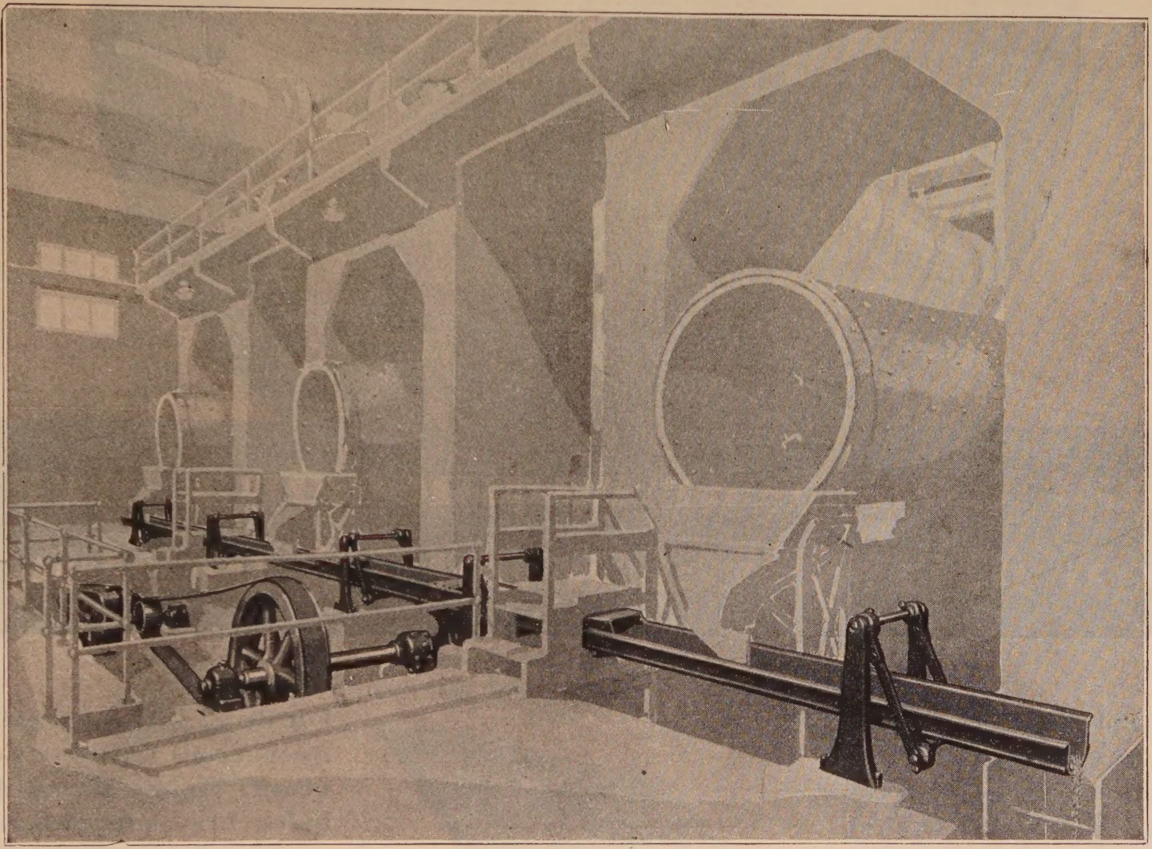
A. D. (Pat) Taggart, Cement City, Mich., has been appointed regional director of the *Dunbrik* industry, in Michigan. Mr. Taggart will have charge of promotional work among architects and engineers in connection with the development of this industry, and also lend his cooperation to plants already established, as well as those now starting.

Subsequent to his wide experience in the sale of sand-lime building units, Mr. Taggart was manager of the Jackson Brick Co. At a former time he also was active in the sales end of concrete products, as well as identified in the promotional work of portland cement plants. He will, for the present, maintain headquarters in Cement City.

MILL SECTION of
Concrete

THE SKIPULTER

(Trade Mark Reg.)



A Skipulter installed in a western cement plant, where it is conveying cement clinker, discharged from three coolers, to an elevator

THE Skipulter is an improved type of shaker conveyor for transporting coarse materials, such as cement clinker, coal, ore, slag, rock, limestone, etc.

It consists of a steel trough, suspended by pendulums, actuated through a flywheel and eccentric into intermittent forward and backward motion. No springs or rollers are employed. The transported material is rapidly and constantly carried forward to point of discharge.

The Skipulter can be arranged to receive different materials at different feed points at the same time, either mixing them or keeping them separated during the transport as desired. And, the discharge can be arranged at either end of the trough or at various intermediate stations as required.

This type of conveyor is one of the simplest means of conveying materials, economical to operate, requiring very little horsepower, and is a simple solution to many conveying problems.

F. L. SMIDTH & COMPANY

Engineers

225 Broadway New York, N. Y.

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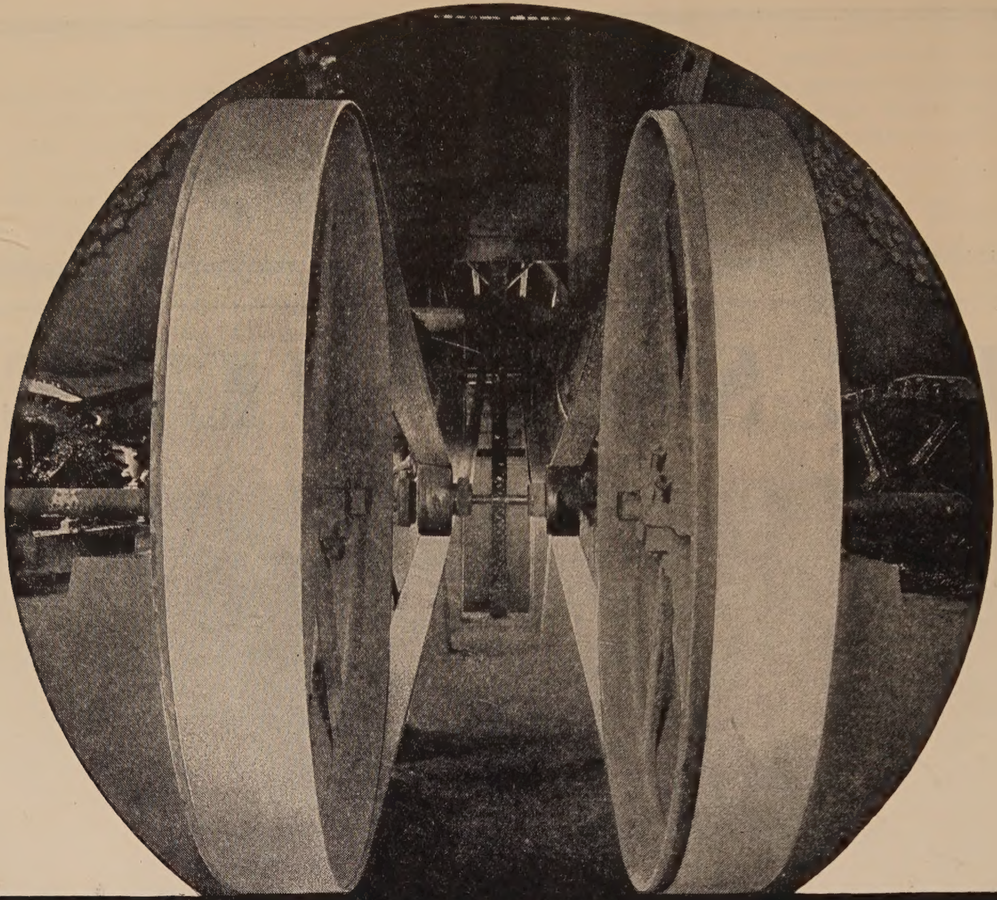

What Goodyear engineering means on drives which eat up belting

On rod and ball mills and kiln drives it means a lot to have drive belts that are built for the work. Goodyear Thor Belts stand up under shocks and blows which break down ordinary belting. They are made of heavy silver-duck plies, cushioned and stoutly buttressed against shocks with rubber of lasting strength. The Goodyear Thor Belt holds rigidly at the fasteners. It comes through with steady power day after day. It saves loss and trouble from shutdowns. It saves high replacement costs.

The G.T.M.—Goodyear Technical Man—knows how to apply Goodyear Transmission Belting to the needs of the cement industry. For drives with open pulleys he recommends Goodyear Compass (Cord) Endless Belts—the new belts for compressors. He specifies Conveyor and Elevator Belting of proper weight and structure for your work. He sees that Air, Water, and Steam Hose give maximum service. To many plants just like yours he has brought handsome savings. To see him, just write to Goodyear, Akron, Ohio, or Los Angeles, California, and ask the G.T.M. to call.

THE GREATEST NAME IN RUBBER

GOODYEAR

BELTS • MOLDED GOODS • HOSE • PACKING

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